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principal author: john e. jankowski, jr.

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foreword

In monitoring the resources used in U.S. science and technology, the National Science Foundation assembles and analyzes information about the money and people devoted to research and development and compares that performance with the efforts under way around the globe. We have been issuing reports since 1956 that summarize national trends. These reports complement the National Science Board's Science & Engineering Indicators, which has been published biennially since 1972, and provide an overview of material presented in several other reports issued by the Division of Science Resources Studies.

As this edition goes to press, we are conducting a review of our procedures to improve the validity, timeliness, accessibility, comprehensiveness, and consistency of these and other data we report. In this *National Patterns*, we have expanded the technical notes and highlighted information about the limitations of our data that will help readers evaluate the uncertainties in our estimates. We are committed to a search for ways to reduce these uncertainties and improve the overall accuracy of our reports.

Users of this publication are encouraged to comment on its content and to report problems encountered with the data to the following office:

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Or telephone the author, John Jankowski, at (202) 634-4248.

Your comments on the use of the material presented here will help our search for better measures.

Daniel Melnick
Director, Division of Science
Resources Studies
Directorate for Scientific,
Technological, and International Affairs

May 1990

acknowledgments

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Supervision and guidance were provided by John R. Chirichiello, Study Director, EASG, and Daniel Melnick, Director, Division of Science Resources Studies. Other staff members of the Science Resources Studies Division provided data for inclusion and reviewed the material for accuracy and currency.

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general notes to the reader:

The National Science Foundation (NSF) sponsors a series of systematic, recurring surveys to collect information on the financial and human resources devoted to research and development (R&D). In this report, such NSF survey data on the various sectors of the U.S. economy—industry, government, academia, and selected nonprofit organizations—are aggregated so that the component pieces of the overall R&D effort are placed in a national context. Information presented in *National Patterns* includes the following:

- the level of R&D expenditures;
- the sources of such funds;
- the sector or organization performing the R&D;
- the character of work undertaken (i.e., whether it is basic research, applied research, or development);
- the number of scientists and engineers employed in R&D; and
- international comparisons with the U.S. effort.

The national totals reported here incorporate data available from the several SRS surveys as of April 26, 1990.

These notes provide a brief introduction to the basic concepts used throughout the report. Important changes and revisions from previous *National Patterns* reports also are highlighted. The reader will find complete definitions, descriptions of projection methodologies, and references to the underlying survey reports in the Technical Notes (appendix a).

Performer-reporting basis. SRS annually surveys Federal Government agencies, industry, and academia. Respondents in each sector indicate the amounts they spend on R&D in their own sector and the sources of these funds. National historical totals are based on data as reported by performers because they are in the best position to (1) indicate how much they spent in the actual conduct of R&D in a given year; (2) classify their R&D by character of work; and (3) identify the sector of the economy in which their financing originated. The consistent use of performer reporting also reduces the possibility of double-counting.

There are exceptions to use of performer-reported data. The last complete survey of the nonprofit (non-academic) sector was conducted in 1973. Although informal surveys of this sector have been undertaken periodically, estimates of the R&D performance by nonprofit organizations reported here are based generally on (1) Federal agency reporting of Federal funding to the nonprofit sector, and (2) R&D performance trends in the other non-Federal sectors.

NSF conducts only occasional surveys of State Government agencies, the last two surveys covering fiscal years (FYs) 1977 and 1987-88. Consequently, the national R&D time series totals exclude estimates of State agencies' intramural R&D performance. State funds for R&D reported by other sectors of the economy, however, are included in the respective R&D performance totals.

One by-product of the decision to use performer-reported data is that the federally-funded R&D performance totals presented in *National Patterns* differ from the Federal R&D funding totals reported by the Federal agencies that provide the funds. A major reason is that performers of R&D often expend Federal funds in a year other than the one in which the Federal Government provides authorization, obligations, or outlays (all defined in appendix a).

Projections. Although respondents continually are given the opportunity to revise prior year(s) data, R&D totals for 1988 reported here are considered to be actual expenditures. Estimates for 1989 generally may be considered "preliminary"; reported 1990 R&D totals are projections.

To the greatest extent possible, this report incorporates data for 1990 R&D programs contained in the Administration's 1991 budget proposal. Where these data are used, it is explicitly noted in the text. The budget, however, does not contain estimates on the detailed disaggregations reported in the *National Patterns;* most importantly, it includes scant information on the economic sectors receiving the Federal funds. Consequently, Federal agencies' R&D performance for 1989 and 1990 are derived from an NSF survey coinciding with the third quarter of FY 1989; the amounts reported for 1989 reflect congressional appropriations, apportionment, and reprogramming decisions as of that time. The 1990 data reflect estimates for R&D programs contained in the Administration's 1990 budget proposal.

Industry R&D performance for 1989 and 1990, with industry as the source of funds, is derived from a 1989 telephone/mail survey of R&D officials in the major R&D-performing industries. Respondents included 72 companies that account for more than one-half of all U.S. company-funded R&D expenditures, and included 17 of the top 20 R&D-spending companies in the United States.

R&D performance estimates for 1989 and 1990 for the other sectors of the economy are derived from time series modeling techniques. Inputs to these models are (1) the performer-reported actual R&D performance data, and (2) information on Federal R&D funding of non-federal sectors, as reported by Federal agencies in the third quarter of FY 1989.

Revisions to industry data. This *National Patterns* is the first to include R&D data based on a new industry sample drawn for survey year 1987. To the sample that was last drawn for 1981, new firms were added and industry classifications were updated. As a result, extensive revisions have been made in the historical industry—and therefore national—R&D time series. Additionally, the methodology used by the Bureau of the Census for imputing character-of-work splits for industry's R&D performance was changed for 1986 and later years; these data are not strictly comparable to data for 1985 and earlier years. The reader should consult the Technical Notes for further discussion of the industry survey changes.

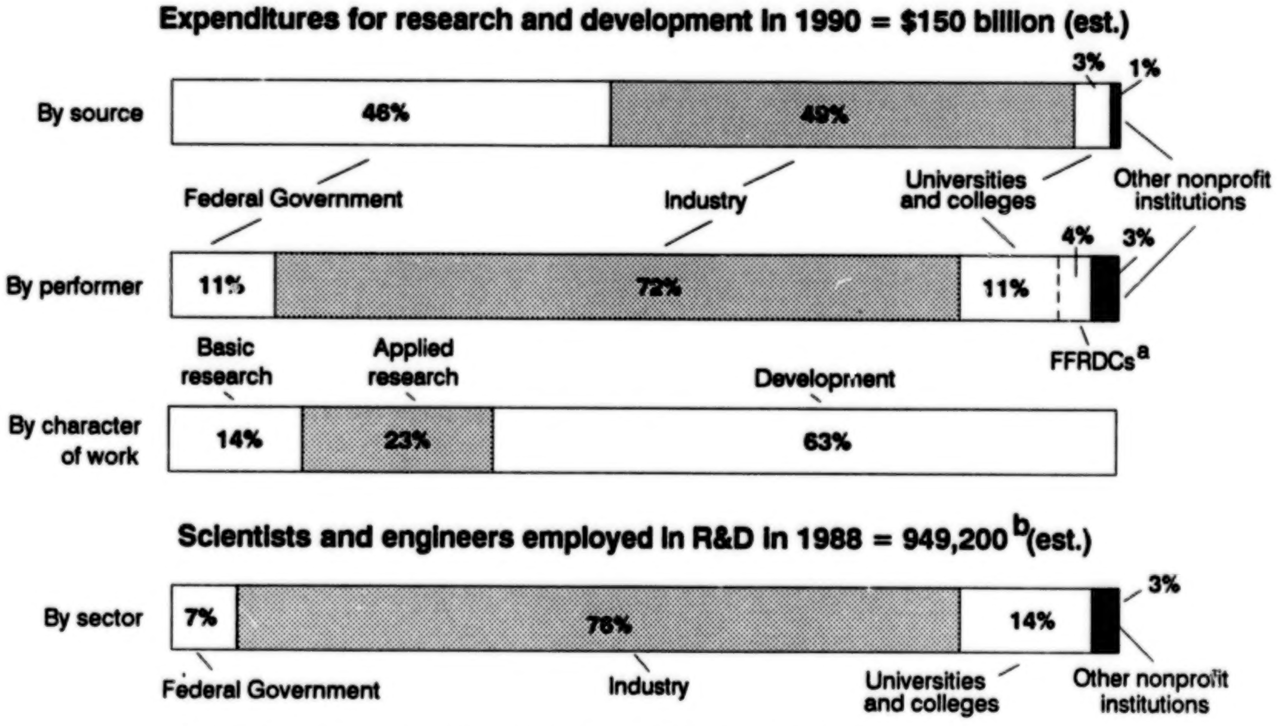
Shortly prior to publication of this report, NSF discovered that the 1986 data on Federal R&D support to industry had been miscalculated. Because data for a merger between two companies were not correctly processed, the federally-funded total was overstated by $356 million. This is equivalent to 1.4 percent of industry's federally-funded R&D performance, or 0.3 percent of the Nation's total R&D performance. Revised 1986 data (and adjustments in 1982-85 data) will be printed in the next edition of this report.

highlights

r&d expenditures

- Total R&D expenditures in the United States are expected to reach $150 billion in 1990, or about 6 percent more than the estimated $142 billion spent in 1989. After adjusting for expected inflation, this is a 1-percent increase and represents the 15th consecutive year of expanding real R&D spending.[1]
- The Federal Government is expected to provide $69 billion in 1990; industry R&D support is estimated at $74 billion (chart 1). Both sources are up roughly 5 percent from 1989 support levels, or about a 1-percent increase in real terms. Most—$4 billion—of the remaining R&D funds are expected from universities and colleges. This is a 12-percent increase from 1989 levels, or 7-percent growth after inflation. (These estimates are based on performer surveys and modeling techniques outlined in the Technical Notes.)

Chart 1. The national R&D effort



[a] Federally funded research and development centers administered by universities and colleges.

[b] Full-time equivalents.

Note: Because of rounding, detail may not add to 100 percent.

SOURCE: National Science Foundation, SRS; tables B-5, B-6, B-7, B-9, B-11, and B-15

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[1] In the absence of a reliable R&D cost index, the implicit price deflator for the gross national product (GNP) is used to convert R&D expenditures to constant 1982 dollars. The GNP deflator includes the effects of price changes for all final goods and services in the economy; therefore, it can indicate only approximate changes in the cost of inputs specifically related to R&D performance.

- R&D growth in the eighties—a 55-percent real increase between 1980 and 1990—was fueled largely by major increases in Federal support for defense-related R&D programs. Defense R&D grew from 50 percent of the Federal R&D budget authority in 1980 to 69 percent in 1986. Since then, growth in civilian-related Federal R&D authorizations has outpaced that of defense-related R&D; nonetheless, defense still accounts for an estimated 62-percent share of the 1990 Federal R&D budget authority—as proposed in the Administration's 1991 Budget. (See pp. 8-9.)[2]
- Growth in total U.S. R&D expenditures has been slow since the mideighties. From 1982 to 1985, R&D spending increased on average by more than 8.5 percent per year in real terms. Over the 1985-90 period, the average annual rate of real R&D growth is estimated at 2.1 percent. Both Federal and non-Federal R&D support has slackened considerably. (See pp. 8.)
- Because of rigorous constraints placed on all parts of the budget, total Federal R&D support (both defense- and civilian-related) slowed from a 6.2-percent average annual real rate of increase during the 1980-85 period to an estimated 2.3-percent annual rate for 1985-90. (See p. 9-10.)
- Over the same 5-year periods, non-Federal support for R&D fell from a 7.5-percent average annual real rate of increase to an estimated 2.0-percent growth rate. Most of the slowing is attributable to a deceleration in industry's R&D funding, which coincides largely with a decline in companies' sales and profit expectations. (See p. 11.)
- As a result of recent R&D trends, the proportion of GNP spent on R&D activities dropped slightly from 2.8 percent in 1985 to an estimated 2.7 percent in 1990. (See p. 13.)

u.s./international comparisons

- The United States spends more money on R&D activities than do France, West Germany, the United Kingdom and Japan combined. As a proportion of 1988 GNP, however, R&D expenditures for the United States (2.8 percent of GNP) are about the same as West Germany's (2.8 percent) and slightly below Japan's (2.9 percent). The 1988 R&D/GNP ratios of France (2.3 percent) and the United Kingdom (2.2 percent) are somewhat lower. (See p. 15.)
- When civilian R&D expenditures are compared to GNP, the U.S. ratio (2.0 percent) is substantially lower than that of Japan (2.9 percent) and West Germany (2.6 percent). The nondefense R&D/GNP ratios are 1.8 percent for France and 1.7 percent for the United Kingdom. (See pp. 15-16.)

r&d performance by sector

- Industry is expected to account for 72 percent of the Nation's 1990 R&D performance total. Its estimated $108 billion R&D performance represents a 5-percent increase from 1989 levels, or 1 percent in real terms. Most (67 percent) of industry's expected R&D performance total will be company-funded; Federal funding is expected to account for the rest. (See pp. 17-19.)
- The Federal Government will perform an estimated $17 billion of R&D in 1990. This is a 6-percent increase over 1989 levels, or—after adjusting for inflation—slightly more than a 1-percent gain. Much of the expected increase is for the intramural R&D activities of the Department of Defense (DOD) and the National Aeronautics and Space Administration (NASA). In total, Federal agencies will account for 11 percent of the expected U.S. 1990 R&D performance. (See pp. 19-20.)
- The Nation's universities and colleges, including university-administered federally funded research and development centers (FFRDCs) are expected to perform 14 percent, or $21 billion, of the total U.S. 1990 R&D effort. Estimated performance by universities and colleges is $16 billion (a 5-percent real gain from 1989), and that by FFRDCs is $5 billion (up 4 percent in real terms). Overall, real R&D performance growth during the 1985-90 period is stronger for the academic sector than for any other sector of the economy. (See pp. 20-21.)

r&d performance by state

- Data are available on the State distribution of 1987 R&D performance by industry, academia, and Federal and State agencies, and the federally funded R&D activities of nonprofit institutions. Six States (California, New York, Michigan, New Jersey, Massachusetts, and Pennsylvania) accounted for one-half of the U.S. total, and 10 States (adding Texas, Illinois, Ohio, and Maryland) accounted for about two-thirds of the national effort. In each of these 10 States, more than $4.5 billion was spent on R&D.

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[2] National Science Foundation, *Federal R&D Funding by Budget Function: Fiscal Years 1989-91*, NSF 90-311, Report (Washington, D.C., 1990).

- The 20 smallest R&D States collectively accounted for 4 percent of the R&D conducted nationwide—about $5 billion in total. (See pp. 23-25.)

character of r&d work

- An estimated $95 billion will be spent on development in 1990. Applied research should reach $34 billion, and $21 billion is projected for basic research. These totals represent inflation-adjusted increases from estimated 1989 levels of 1 percent for development, 0.4 percent for applied research, and 4 percent for basic research.
- As a share of the expected 1990 R&D total, development accounts for 63 percent of U.S. expenditures, applied research for 23 percent, and basic research for 14 percent. (See p. 27.)
- Much of the decade's growth in development was a result of the major increases in Federal support for defense R&D, which is about 90 percent development. (See p. 28.)

r&d scientists and engineers

- According to institutional performer-based surveys for 1988, the estimated full-time equivalent (FTE) of 949,200 scientists and engineers were employed in R&D activities. This represented a 3-percent increase from 1987 and was 62 percent more than the 1978 level. Most of the growth occurred in the industrial sector. In 1988, industry spent an average $140,000 on R&D per each FTE R&D scientist and engineer. (See p. 29.)
- There were 419,100 employed doctoral scientists and engineers in the United States in 1987, a 47-percent increase from 1977. (The latest data available are for 1987.) These doctorate-holders reported that they were involved in R&D activities more than in any other type of work. In 1987, R&D accounted for 45 percent of their primary work activities reported. (See p. 29.)

trends in national r&d support

U.S. expenditures on R&D are expected to reach an estimated $150 billion in 1990 (chart 2). This would be a 5-percent increase from estimated 1989 levels—$142 billion—or 1-percent growth after adjusting for expected inflation.[3] The Federal Government will provide 46 percent ($69 billion) of total funds; and non-Federal sectors of the economy, i.e., industry, State Governments, universities and colleges, and other nonprofit institutions, will provide the remaining 54 percent ($81 billion). The 1990 increase is a continuation in a trend of relatively small annual gains in R&D expenditures that began in 1986.

The 1986 shift to slow R&D growth, however, is only the most recent of several notable turning points in R&D spending patterns that have occurred during the past 20 years. Starting in 1968 and for nearly a decade, R&D growth failed to keep up with either inflation or general increases in economic output. In fact, between 1968 and

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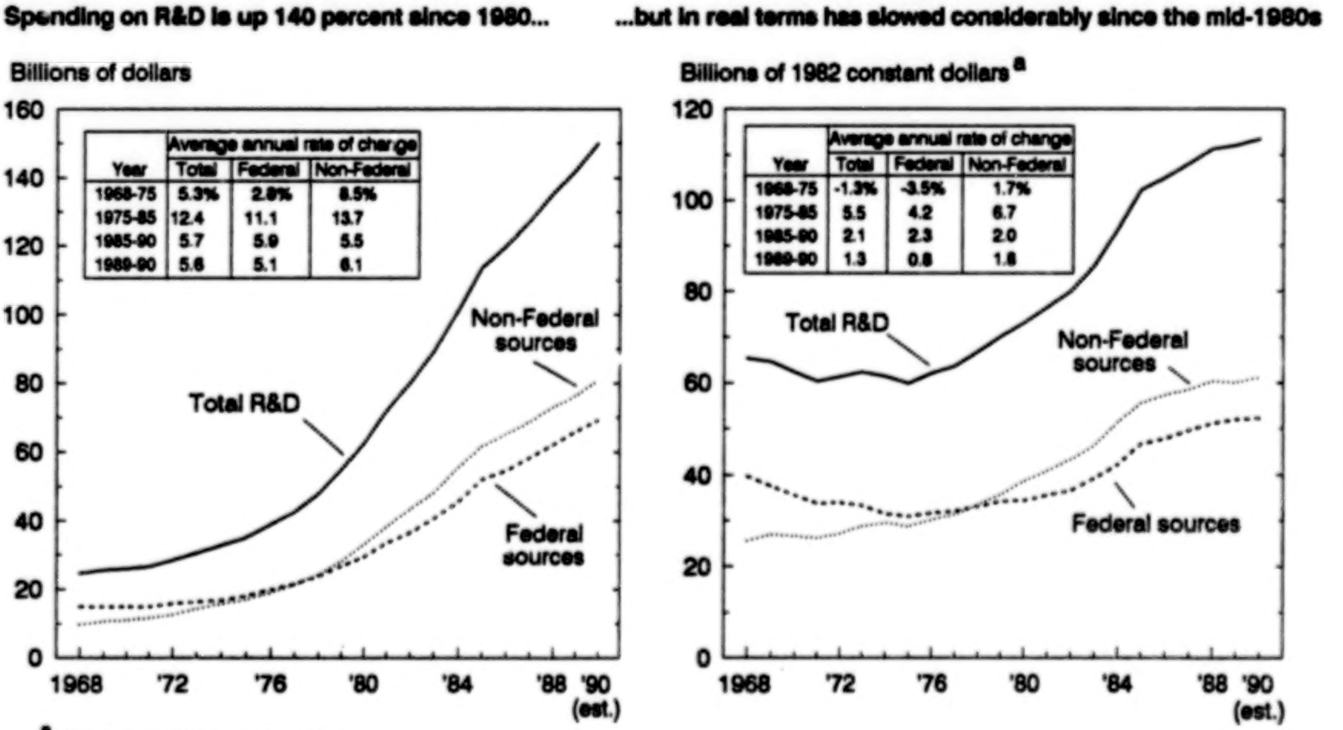
[3] Real growth for 1990 is derived using the Office of Management and Budget GNP implicit price deflator estimate of 4.2 percent.

Chart 2. National R&D funding by source



Spending on R&D is up 140 percent since 1980...

Year	Average annual rate of change		
	Total	Federal	Non-Federal
1968-75	5.3%	2.8%	8.5%
1975-85	12.4	11.1	13.7
1985-90	5.7	5.9	5.5
1989-90	5.6	5.1	6.1

...but in real terms has slowed considerably since the mid-1980s

Year	Average annual rate of change		
	Total	Federal	Non-Federal
1968-75	-1.3%	-3.5%	1.7%
1975-85	5.5	4.2	6.7
1985-90	2.1	2.3	2.0
1989-90	1.3	0.8	1.8

[a] Based on GNP implicit price deflator.

SOURCE: National Science Foundation, SRS; table B-5

1975, real R&D expenditures declined almost 9 percent. Federal support, in particular, fell precipitately during this period (down 22 percent in real terms): both defense- and nondefense-related R&D programs declined.

Following recovery from the 1974 oil embargo and 1975 recession, a significant funding reversal occurred. U.S. R&D expenditures more than tripled within just 10 years, climbing from $35 billion in 1975 to $114 billion in 1985. When adjusted for inflation, the 10-year increase was approximately 71 percent.

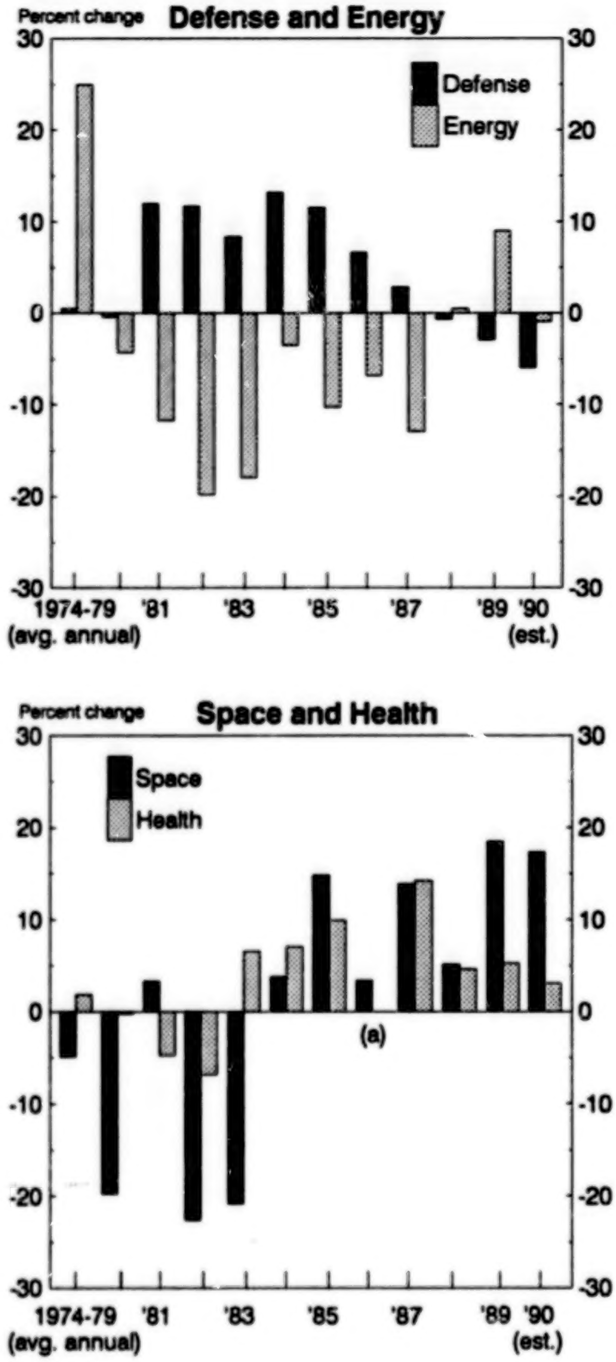
During the first half of this period (1975-80), there was considerable growth in Federal R&D funding for nondefense activities. Although defense-related R&D expenditures rose annually, much of the Federal R&D gain was attributable to energy-related R&D (particularly nuclear energy development) and to greater support for health-related R&D (chart 3). Non-Federal R&D increases were concentrated in industry, and resulted largely from greater emphasis on energy conservation and improved use of fossil fuels. Consequently, energy concerns fostered increases in R&D funding by both Federal and non-Federal sources: support for energy R&D rose 140 percent in real terms between 1974 and 1979, and accounted for one-half of the national increase in real R&D spending.

Overall, the U.S. constant-dollar investment in total R&D grew at an average annual rate of 4.1 percent during the 1975-80 period. Although the rate of increase remained rather steady through 1982 (4.5 percent annually), the focus of the national R&D effort began to shift heavily toward defense-related activities in the early eighties.[4] Largely as a result of increases in defense R&D, growth in total R&D expenditures accelerated to an 8.5-percent average annual rate over the 1982-85 period: not since the space-inspired spending bulge in the early sixties had R&D in the United States grown so rapidly during any 3-year period.

This pattern of a generally increasing rate of R&D growth, however, changed abruptly. From 1985 to 1988, R&D spending slowed to a 3-percent annual real rate of increase; slackening in both Federal and non-Federal support contributed to this slowing. R&D growth in 1989 and 1990 is estimated to decelerate further, slowing to a 1-percent real increase each year.

Chart 3. Changes in Federal R&D authority for selected functions

(Based on 1982 constant dollars)



Defense and Energy

Space and Health

[a] No change in health R&D in 1986.

SOURCES: National Science Foundation, SRS, and Office of Management and Budget

federal support, 1980-90

Since the early eighties, the Federal Government has consistently provided about 46 percent of all funds spent on R&D in the United States. Total (defense- and civilian-related) Federal R&D support grew from $29 billion in 1980 to an estimated $69 billion in 1990, or about a 52-percent increase after adjusting for inflation. The real rate of increase was particularly strong in the first half of the decade: from 1980 to 1985, Federal R&D support grew on average by 6.2 percent annually. Support then slowed considerably in 1986 reflecting the budgetary constraints imposed on all Government programs, including those mandated by the Gramm-Rudman-Hollings Act.[5] As a consequence, real Federal R&D support is estimated to increase on average by 2.3 percent per year over the 1985-90 period.

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[4] Industry R&D expenditures on energy and pollution abatement also slowed in the early eighties. During 1981 and 1982, such expenditures increased at only one-third the rate reported for the previous four years.

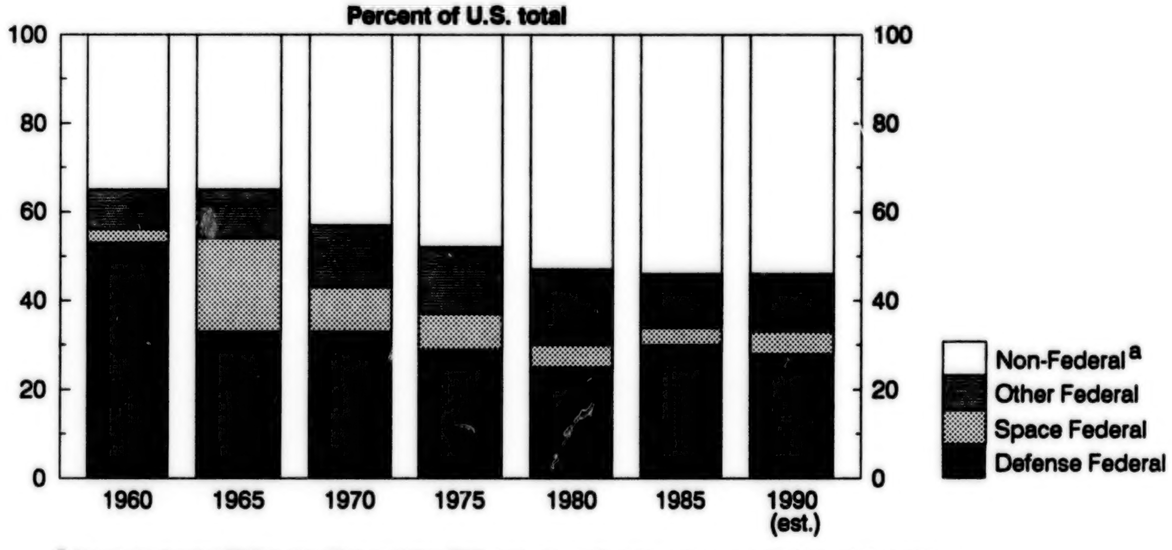
Much of the gain in Federal R&D support during the eighties was a result of large increases in defense spending. This is borne out by data on U.S. budget authority. For example, defense activities of DOD and the Department of Energy (DOE) accounted for one-half of total Federal R&D budget authorizations in 1980.[6] By 1986, such defense-related spending peaked at 69 percent of the Federal R&D budget authority.

In each year since then, the growth rate in Federal authority for civilian-related R&D has been higher than for defense-related R&D. Increases for health- and space-related R&D are particularly strong, while estimated R&D for defense programs declines annually—in real terms—during the 1988-90 period. As a result, defense-related R&D accounts for an estimated 62 percent of the 1990 total Federal R&D budget authority, as proposed in the Administration's 1991 budget.

[For the Nation as a whole, defense R&D climbed from 25 percent of the total R&D effort in 1980 to 30 percent in 1985. In 1990, defense R&D is expected to settle back to a 28-percent share of total (Chart 4). These shares by national objective represent a distribution of performer-reported R&D data. They are distinct from the budget authority shares, reported above, that are based on the various functional categories that compose the Federal budget. (See Technical Notes, appendix a.)]

R&D is estimated to account for 13 percent[7] of the 1990 defense-related budget authority and 3 percent of all Federal nondefense funds (table 1). Despite a slight decline in total defense R&D authorizations (table B-21), the

Chart 4. R&D spending by national objective and source



[a] All industry-funded R&D is classified as civilian R&D, including outlays by aerospace and electronic industries.
SOURCE: National Science Foundation, SRS; table B-13

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[5] The Balanced Budget and Emergency Deficit Control Act of 1986.

[6] These percentage share estimates of defense-related R&D expenditures are based on the President's 1991 Federal budget authorization totals, not on data reported by the actual R&D performers. They do not include subsequent congressional or agency changes.

[7] National Science Foundation, *Federal R&D Funding by Budget Function: Fiscal Years 1988-91*, op. cit. These data reflect estimates contained in the Administration's 1991 Federal budget proposal.

Table 1. Budget authority for R&D as a percent of enacted total Federal budget authority by function: 1990

[Dollars in millions]

Function	R&D total	Federal total	R&D percent share
Total budget	$63,805	$1,337,621	4.8%
On-budget	63,805	1,078,980	5.9
National defense	39,877	301,631	13.2
Non-defense (on-budget)	23,928	777,349	3.1
Energy	2,911	5,611	51.9
Health	8,358	60,341	13.9
General science	2,499	3,202	78.0
Space research and technology	5,577	11,394	48.9
Natural resources and environment	1,362	16,955	8.0
All other	3,221	679,846	0.5

NOTE: Derived from the Administration's 1991 budget proposal.

SOURCES: National Science Foundation, SRS, and Office of Management and Budget

President's budget provides for increases in selected programs such as the space-based antiballistic Strategic Defense Initiative and the Advanced Tactical Fighter. In nondefense areas, R&D should account for 78 percent of general science funds, 95 percent of which is devoted to the conduct of basic research and includes funding for the Superconducting Super Collider and increases in the NSF budget; 52 percent of energy funds; 50 percent of space funds, with major funding increases slated for continued development of the planned manned Space Station; and 14 percent of health funds, with increased funding for Acquired Immunodeficiency Syndrome/Human Immunodeficiency Virus (AIDS/HIV) research.

indirect federal encouragement

In addition to increases in direct Federal support for R&D, other Federal efforts have stimulated national R&D spending during the eighties. For example, the Economic Recovery Tax Act (ERTA) of 1981 provided a 25-percent tax credit for companies' incremental spending on qualified R&D through calendar year 1985. Since initial passage of the Act, its R&D credit provisions have been thrice extended and are currently in place through September 1990.[8]

Congress also has sought to encourage industry support specifically for basic research. The Tax Reform Act of 1986 allowed companies to claim a 20-percent tax credit on basic research grants, contributions, and contracts to universities and other qualifying nonprofit research organizations. This tax credit provision is due to expire after September 1990.

Furthermore, programs have been set in place to help strengthen the R&D links between industry, university, and government laboratories. This is reflected in programs such as the Engineering Research Centers and Science and Technology Centers funded by NSF, and the Centers for the Commercial Development of Space funded by NASA. Federal laws have been enacted—notably the 1986 Federal Technology Transfer Act—to promote the transfer of technology from Federal laboratories to State and local governments and the private sector. The 1986 Act also formally established the Federal Laboratory Consortium for Technology Transfer (FLC), a networking organization of more than 300 Federal laboratories, research centers, and their technology transfer offices.[9] Each of the larger Federal laboratories is required to have an Office of Research and Technology Applications (ORTA) that identifies and disseminates information on Federal R&D projects with potential applications in other economic sectors. With the signing of the Omnibus Trade and Competitiveness Act of 1988, the National Bureau of Standards—renamed the National Institute of Standards and Technology—was given a lead role in facilitating private sector access and commercialization of promising R&D projects through cooperative efforts among all sectors of the economy. Federal agencies will spend an estimated $510 million on technology transfer activities in 1990.[10]

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[8] ERTA provided a 25-percent tax credit—between July 1, 1981, and December 31, 1985—for qualified R&D expenditures in excess of a threshold equal to the average qualified expenditures of a taxpayer during the three previous years. The Tax Reform Act of 1986 extended the R&D credit through 1988 at 20 percent, but for a somewhat narrower and stricter definition of qualified R&D. This Act also provided for a basic research tax credit during calendar years 1987 and 1988. (See text.) Both tax credits were extended through 1989 by the Technical Corrections and Revenue Act of 1988. With the signing of the 1989 Omnibus Reconciliation Act, the credits received a 9-month extension.

[9] The FLC evolved from a consortium created by DOD in 1971.

[10] Office of Management and Budget, "Special Analysis J," *The Budget of the United States Government, Fiscal Year 1990* (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, 1989).

non-federal support, 1980-90

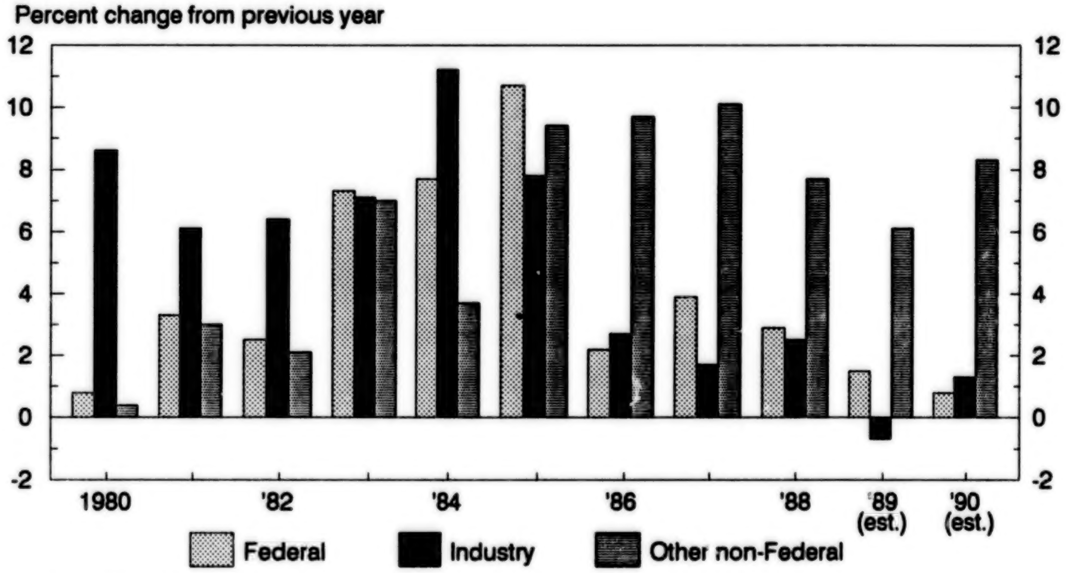
Concurrent with gains in Federal R&D spending, R&D support from non-Federal sources also increased substantially in the first half of the eighties—up on average by 7.5 percent per year in real terms between 1980 and 1985. Since then, non-Federal support in real dollars has slowed to an estimated 2.0-percent average annual rate.

Most non-Federal R&D support is provided by industry. Of the estimated 1990 non-Federal total ($81 billion), 92 percent ($74 billion) will be company-funded. From 1980 to 1985, industrial support for R&D increased at a 7.7-percent average annual inflation-adjusted rate; this growth was maintained through both the mild 1980 recession and the more severe 1982 recession (chart 5). Key factors behind industry's R&D increases included a growing concern with international competition, especially in high-technology industries; the increasing technological sophistication of products, processes, and services; and general growth in defense-related industries such as electronics, aircraft, and missiles.

Between 1985 and 1990, growth in R&D support from industry is estimated at only one-fifth the rate of the previous five years, averaging 1.5-percent growth per year in real terms. Although this slowdown cannot be linked to any single cause, company officials cite smaller increases in sales and profit expectations as the major reason for the deceleration in their R&D funding. Respondents to an NSF survey also note that increases in the real cost of capital and in the number of corporate mergers and acquisitions may have served somewhat to curb R&D growth rates.[11]

In contrast to the recent sluggishness in industrial R&D support, support from other non-Federal sectors—universities, State and local governments, and other nonprofit institutions—has been increasing. Between 1980 and 1985, average annual rate of real R&D support from these sectors was 4.9 percent. Increases in non-Federal non-industry real R&D support is estimated at 8.4 percent per year during the 1985-90 period. Most of these R&D dollars are used for research by the academic sector.

Chart 5. Changes in national R&D spending by source of funds
(Based on constant 1982 dollars)



SOURCE: National Science Foundation, SRS; table B-5

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[11] National Science Foundation, "Slow R&D Spending Growth Continues into 1990s," *Science Resources Studies Highlights*, NSF 90-307 (March 9, 1990).

measures and comparisons of national resources for r&d

In this section, two indicators of R&D spending are examined—(1) the ratio of total R&D expenditures to GNP, and (2) the ratio of Federal funds expended for R&D to total Federal funds. Also, a comparison of U.S. R&D resources to those of other countries is presented. These measures and comparisons show that, overall, and despite a recent leveling trend, the U.S. commitment to R&D has increased considerably during the past decade. Relative to its major international competitors, however, the U.S. R&D effort has eroded slightly.

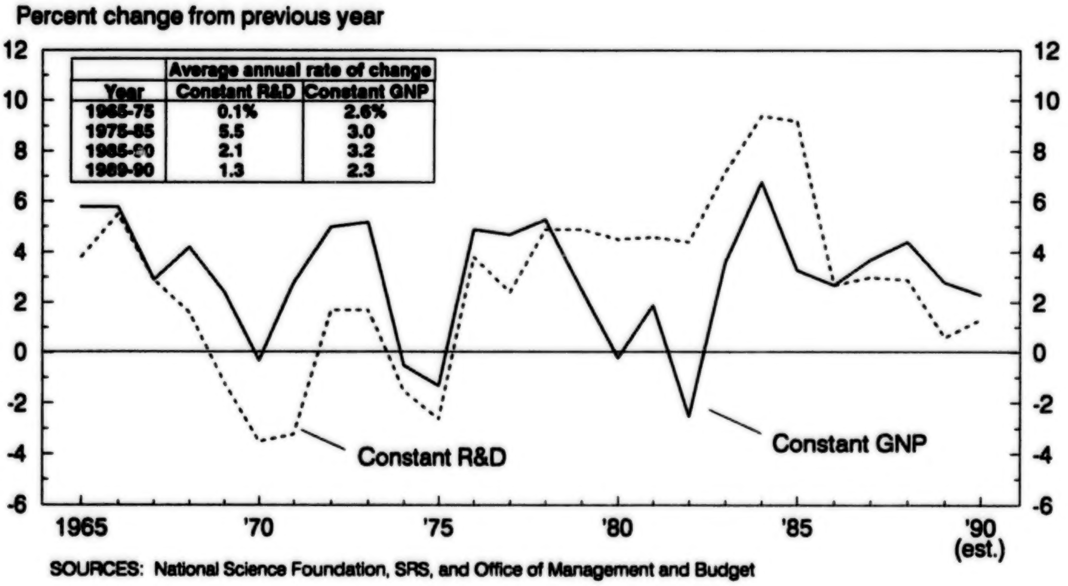
u.s. r&d/gnp ratio

The ratio of R&D expenditures to GNP may be used as a measure of the Nation's commitment to R&D. In 1990, total U.S. support for R&D is expected to total $150 billion; this equals 2.7 percent of an estimated $5.58 trillion GNP. This percentage share is virtually unchanged from the estimated 1989 ratio (table B-14).

Reviewing the U.S. R&D/GNP ratio over time shows a peak of 2.9 percent in 1964 with a gradual decline to 2.1 percent in 1978. This drop largely reflected Federal cutbacks in defense and space R&D programs, although gains in energy R&D activities between 1975 and 1979 resulted in a relative stabilization of the ratio at around 2.1-to-2.2 percent. Over the entire 1965-78 period, the annual percentage increase in real R&D was less than the annual percentage increase in real GNP. In years that real R&D spending decreased, real GNP also fell but at a lower rate (chart 6).

From 1979 to 1985, the R&D/GNP ratio increased steadily from 2.2 percent to 2.8 percent. This increase was as

Chart 6. Annual changes in GNP and R&D: 1965-90
(Based on constant 1982 dollars)



	Average annual rate of change	
Year	Constant R&D	Constant GNP
1965-75	0.1%	2.6%
1975-85	5.5	3.0
1985-90	2.1	3.2
1989-90	1.3	2.3

SOURCES: National Science Foundation, SRS, and Office of Management and Budget much due to a slowdown in GNP growth as to increased spending on R&D activities. For example, the 1980 and 1982 recessions resulted in a slight decline in real GNP; there was no corresponding reduction in R&D spending. In contrast, during previous recessions, changes in support for R&D tended to parallel—and even exceed—the adverse movements of broader economic measures. Since 1985, the R&D/GNP ratio has declined slightly as a result of slow R&D expenditure growth, coupled with slow but continued expansion in the national economy.

u.s. federal r&d funds/ total budget ratio

One way to gauge the Government's priority for R&D is to compare Federal outlays for R&D to Federal outlays for all purposes. In 1990, total Federal outlays (for on-budget programs only) are estimated at $971 billion.[12] An estimated 6.5 percent ($63 billion) of total outlays is for R&D; this is largely unchanged from the 1989 R&D/total outlay ratio (chart 7).

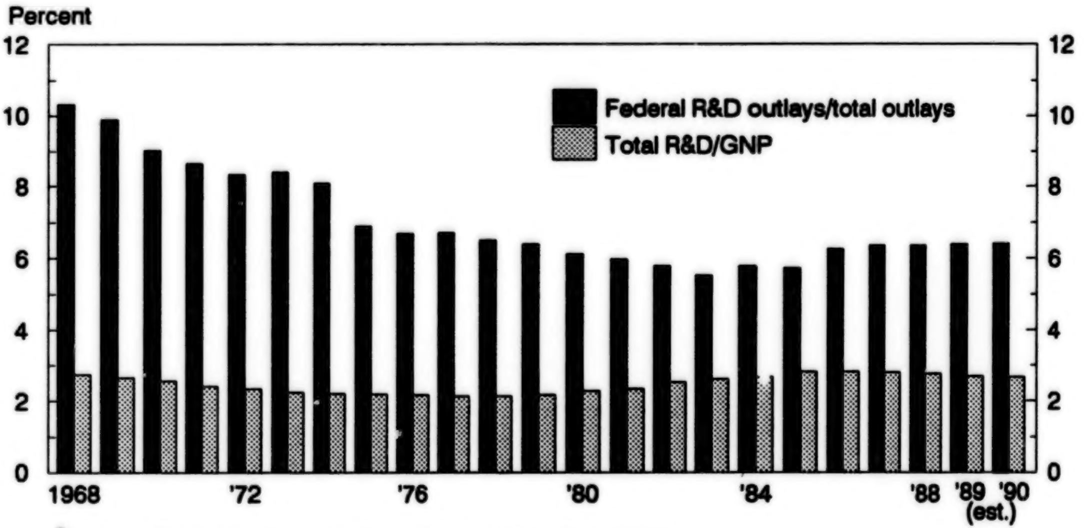
From 1968 to 1983, R&D outlays as a percentage of total outlays declined steadily, dropping from 10.3 percent to 5.5 percent. The rate of decline was most rapid in the late sixties and early seventies, and slowed considerably from 1975 on. The 1968-74 decrease in the R&D outlay ratio from the high levels of the sixties, is explained partially by a general de-emphasis on R&D which prevailed before the first oil embargo; part undoubtedly stemmed from a reduction in defense expenditures.

In contrast to this earlier period, R&D outlays generally held their own during the mid- and late seventies when budget-wide outlay increases were growing rapidly. The Federal R&D outlay ratio dropped only from 6.9 percent in 1975 to 5.5 percent in 1983. This was barely one-third the percentage-point drop reported for the previous 8-year period and is in itself a good indication of the higher priority then accorded R&D funding. Since its 5.5-percentage-share low in 1983, the annual R&D outlay has fluctuated somewhat, although the tendency has been to increase rather than decline.

international comparisons

The R&D/GNP ratio discussed above can be used to determine the relative emphasis placed on R&D activities by the United States and other countries. Another useful measure is to compare the number of R&D scientists and

Chart 7. R&D/GNP ratio compared to Federal R&D/total budget outlay ratio [a]



[a] Excludes off-budget outlays, which are mostly for social security programs.
NOTE: Estimates for 1989 and 1990 are based on the Administration's 1991 budget.
SOURCES: National Science Foundation, SRS, Department of Commerce, and Office of Management and Budget

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[12] Almost all off-budget receipts and disbursements are for Social Security programs (the Federal Old-Age and Survivors Insurance and the Federal Disability Insurance trust funds) which are excluded from the budget totals by the Balanced Budget and Emergency Deficit Control Act of 1985. Off-budget outlays for FY 1990 are estimated at $226 billion. Outlays are those provided in the President's 1991 budget proposal, Office of Management and Budget, *The Budget of the United States Government, Fiscal Year 1991 (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, 1990).*

engineers in a country with its total labor force. Use of these ratios bypasses many of the problems in interpretation caused by inflation, exchange rate fluctuations, different unit costs, and variations in the volume of research efforts. Caution must nonetheless be exercised in making even these international comparisons, because each country compiles its R&D and personnel data differently from the others.

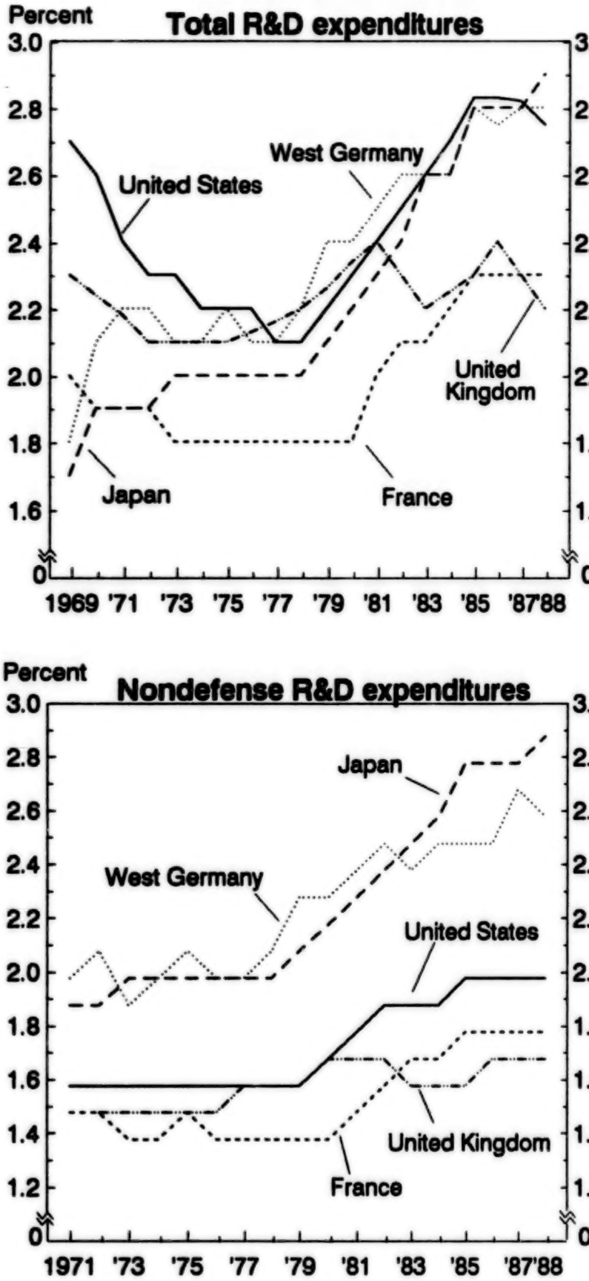
R&D/gnp ratios. The United States spends more money on R&D activities than does any other country; in fact, it spends more than France, West Germany, the United Kingdom, and Japan combined.[13] The U.S. ratio of R&D funds to GNP, however, is roughly comparable to those of West Germany and Japan. In 1988—the latest year of available foreign data—the R&D/GNP ratio for the U.S. and West Germany was 2.8 percent, and for Japan was 2.9 percent. In comparison, the ratio for France was estimated at 2.3 percent in 1988; the United Kingdom's R&D/GNP ratio was 2.2 percent.

During the early to midsixties, the United States ranked highest among these countries in terms of both R&D expenditures and R&D/GNP ratios (almost 3 percent). After 1964, however, the U.S. ratio began to decline as Federal R&D spending for defense and space was cut back while the U.S. GNP continued to increase. At the same time, the ratios in other countries—notably West Germany and Japan—slowly increased. These divergent trends continued until the midseventies, by which point the U.S. ratio had dropped to 2.1 percent and was about equal to those in West Germany, the United Kingdom, and Japan (chart 8).

During the late seventies and early eighties, the ratios in all countries were again increasing and by 1985 had reached 2.8 percent in the United States, West Germany, and Japan; 2.3-percent R&D/GNP ratios were reported for France and the United Kingdom. Since then, Japan's ratio has increased slightly, the U.S. and U.K. ratios have declined slightly, and those in the other three countries have remained virtually unchanged.

If defense activities are excluded from the R&D data, the gap between the United States and the two other leading R&D-performing countries widens. The nondefense R&D/GNP ratio for the United States in 1988 (2.0 percent) was considerably lower than those for West Germany (2.6 percent) and Japan (2.9 percent) (chart 8).[14] About 70 percent of the U.S. R&D effort was devoted to nondefense activities, as compared to more than 90 percent in these two countries. France and the United Kingdom reported

Chart 8. R&D expenditures as a percent of gnp by country



SOURCES: National Science Foundation, SRS, and Organisation for Economic Cooperation and Development; tables B-18 and B-19

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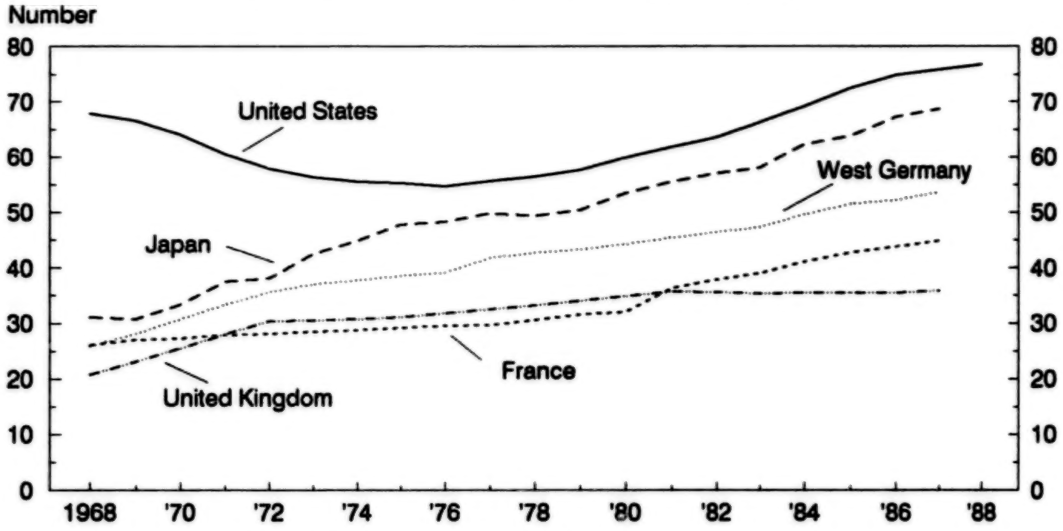
[13] For example, the United States spent $106 billion on R&D in 1988 (constant 1982 dollars). Comparable R&D expenditures, based on purchasing power parity exchange rates, for Japan were $37 billion; for West Germany, $19 billion; and $14 billion each for the United Kingdom and France. See National Science Foundation, *International Science and Technology Update: 1989*, NSF 89-307, Report (Washington, D.C., 1989).

[14] The GNP figures used here to derive nondefense R&D/GNP ratios include defense-related GNP. If GNP data exclusive of military expenditures are used instead, the nondefense R&D/GNP ratios are not significantly effected—by less than 0.3 percentage points for any single country in any single year. Nondefense GNP data are derived from information reported in U.S. Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers: 1987* (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, March 1988).

Chart 9. Scientists and engineers engaged in R&D per 10,000 labor force by country



SOURCES: National Science Foundation, SRS, and Organisation for Economic Cooperation and Development; table B-17

nondefense R&D/GNP ratios of 1.8 percent and 1.7 percent, respectively.

R&D scientists and engineers/labor force ratios. Comparing the number of scientists and engineers employed in full-time equivalent R&D jobs with the total labor force results in a ratio higher in the United States than in the other industrialized market economies. There were about 77 FTE R&D professionals per 10,000 in the U.S. labor force in 1988 (chart 9); this ratio increased annually after 1976—when it was 55 per 10,000.

Ratios in the United Kingdom, Japan, Germany and France also have been increasing annually. The rate of growth in Japan has been especially rapid. Japan's R&D/labor force ratio increased from 50 R&D professionals per 10,000 workers in 1979 to 69 per 10,000 in 1987, which is the latest year of available foreign data.[15] By comparison, there were 36 FTE R&D professionals per 10,000 in the United Kingdom in 1987, 45 per 10,000 in France, and 54 per 10,000 in West Germany.

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[15] Japanese and U.S. surveys on the number of scientists and engineers engaged in R&D are not strictly comparable. Except for scientists and engineers employed by the Federal Government, the U.S. data are adjusted to estimate full-time equivalence: Japanese surveys, on the other hand, ask for the total number of scientists and engineers engaged in R&D regardless of the amount of time devoted to R&D. In this report, the Japanese data on scientists and engineers exclude those engaged in R&D in the social sciences and humanities. For the United States, such personnel are excluded from the industry sector alone.

national r&d performance patterns—by sector

The sectoral shares of U.S. R&D performance have shifted slightly during the past decade. In 1980, industry performed 71 percent of the Nation's R&D; the academic sector—including FFRDCs administered by universities—accounted for 13 percent; the Federal Government for 12 percent; and the nonprofit sector, 3 percent. As industry's defense-related R&D efforts accelerated in the early eighties, its share of the performance total rose to a 1985 peak of 74 percent. Concurrently, academic R&D performance slipped slightly to 12 percent of the U.S. total, and the Federal share dropped to 11 percent. The nonprofit R&D share remained at 3 percent in 1985.

Growth in academic R&D performance has since outpaced that of the other sectors. From 1985 to 1990, real R&D performance growth by universities and colleges (excluding FFRDCs) is estimated at a 6.6-percent annual rate, compared to average annual real growth of 1.5 percent for industry. Federal intramural performance growth during this period is estimated at a 1.7-percent average annual rate, and the estimated change in R&D performance by the nonprofit sector is relatively flat (0.4-percent annual real growth). In 1990, industry is expected to account for 72 percent of the national R&D performance total. Academia's share should climb to 14 percent; the Federal Government's share is estimated at 11 percent; and the nonprofit sector is expected to account for 3 percent of U.S. R&D performance (table 2).

industry

Projections and trends. R&D performance by industry—including that performed by FFRDCs administered by industrial firms—is projected to reach an estimated $108 billion in 1990. This is a 5-percent increase from the estimated 1989 level, or 1-percent growth in real terms (table 2 and chart 10).[16]

Among the five largest R&D-performing industries, the chemicals industry expects the highest rate of company-funded R&D growth in 1990 (a 10 percent increase in current-dollar terms). The aircraft industry expects a 7-percent increase in its 1990 R&D budget; professional and scientific instruments, a 6-percent increase; and both the motor vehicles and machinery/electrical equipment industries, roughly a 4-percent gain.[17]

For all industries combined, non-Federal—primarily company—financing of industrial R&D performance is expected to increase 5 percent in 1990, or 1 percent in real terms; Federal funds for industry's R&D activities are expected to be unchanged after adjusting for inflation. Overall, companies are expected to fund about 67 percent ($73 billion) of their R&D performance and the Federal Government to fund the rest ($36 billion). These industry R&D financing shares have remained relatively unchanged for the past decade.

From 1980 to 1985, company funds for industry R&D performance grew at an average annual real rate of 7.7 percent; Federal R&D funds to industry—largely for defense, but also for space and other nondefense programs—increased on average 8.4 percent annually. In the 1985-90 period, company funding of industrial R&D performance fell to a 1.3-percent average annual rate, whereas real Federal financing slowed to an estimated 2.0-percent rate. Overall, annual growth in industry's real R&D performance dropped from 7.9 percent in the 1980-85 period to a 1.5 percent estimated rate since 1985.

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[16] Industry R&D price deflators developed by Professor Edwin Mansfield of the University of Pennsylvania indicate that the GNP implicit price deflator overstates real spending by about 1 percent per year. See "Price Indexes for R and D Inputs, 1969-1983," *Management Science*, Vol. 33, No. 1, January 1987, pp. 124-129.

[17] National Science Foundation, "Slow R&D Spending Growth Continues into 1990s," op. cit.

By industry grouping.[18] The most recent year for which detailed industry-specific data are available by all sources of funds is 1988. The largest R&D-performing industries then were aircraft and missiles—accounting for one-fourth of the Nation's industrial R&D performance total—and electrical equipment—accounting for approximately one-

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[18] A company is assigned entirely to the industry accounting for its most dominant economic activity in terms of total company payroll, even though the firm may produce products in several industries.

Table 2. Intersectoral transfers of funds used for performance of research and development, basic research, applied research, and development: 1990 (estimated) (Dollars in millions)

	Performers						
Sources of Funds	Federal Government	Industry[1]	Universities and colleges	U&C associated FFRDCs[2]	Other[1] nonprofit institutions	Total	Percent distribution, sources
			RESEARCH AND DEVELOPMENT				
Federal Government.................	16,700	35,650	9,200	5,250	2,400	69,200	46.1 %
Industry......................................	—	72,500	1,150	—	600	74,250	49.5
Universities and colleges..........	—	—	4,300	—	—	4,300	2.9
Other nonprofit institutions........	—	—	1,150	—	1,100	2,250	1.5
Total..........................	16,700	108,150	15,800	5,250	4,100	150,000	100.0
Percent distribution, performers..............................	11.1%	72.1%	10.5%	3.5%	2.7%	100.0%	
			BASIC RESEARCH				
Federal Government.................	2,400	700	6,550	2,750	850	13,250	61.7%
Industry......................................	—	3,500	700	—	280	4,480	20.8
Universities and colleges..........	—	—	2,620	—	—	2,620	12.2
Other nonprofit institutions........	—	—	700	—	440	1,140	5.3
Total..........................	2,400	4,200	10,570	2,750	1,570	21,490	100.0
Percent distribution, performers..............................	11.2%	19.5%	49.2%	12.8%	7.3%	100.0%	
			APPLIED RESEARCH				
Federal Government.................	3,550	5,700	2,325	740	650	12,965	38.4%
Industry......................................	—	18,100	370	—	200	18,670	55.3
Universities and colleges..........	—	—	1,380	—	—	1,380	4.1
Other nonprofit institutions........	—	—	370	—	400	770	2.3
Total..........................	3,550	23,800	4,445	740	1,250	33,785	100.0
Percent distribution, performers..............................	10.5%	70.4%	13.2%	2.2%	3.7%	100.0%	
			DEVELOPMENT				
Federal Government.................	10,750	29,250	325	1,760	900	42,985	45.4%
Industry......................................	—	50,900	80	—	120	51,100	53.9
Universities and colleges..........	—	—	300	—	—	300	0.3
Other nonprofit institutions........	—	—	80	—	260	340	0.4
Total..........................	10,750	80,150	785	1,760	1,280	94,725	100.0
Percent distribution, performers..............................	11.3%	84.6%	0.8%	1.9%	1.4%	100.0%	

[1] Expenditures for FFRDCs administered by both industry and nonprofit institutions are included in the totals of their respective sectors. They are estimated to account for less than 5 percent and 25 percent, respectively, of the industry and nonprofit institutions performance totals. FFRDCs are organizations exclusively or substantially financed by the Federal Government to meet a particular requirement or to provide major facilities for research and training purposes.

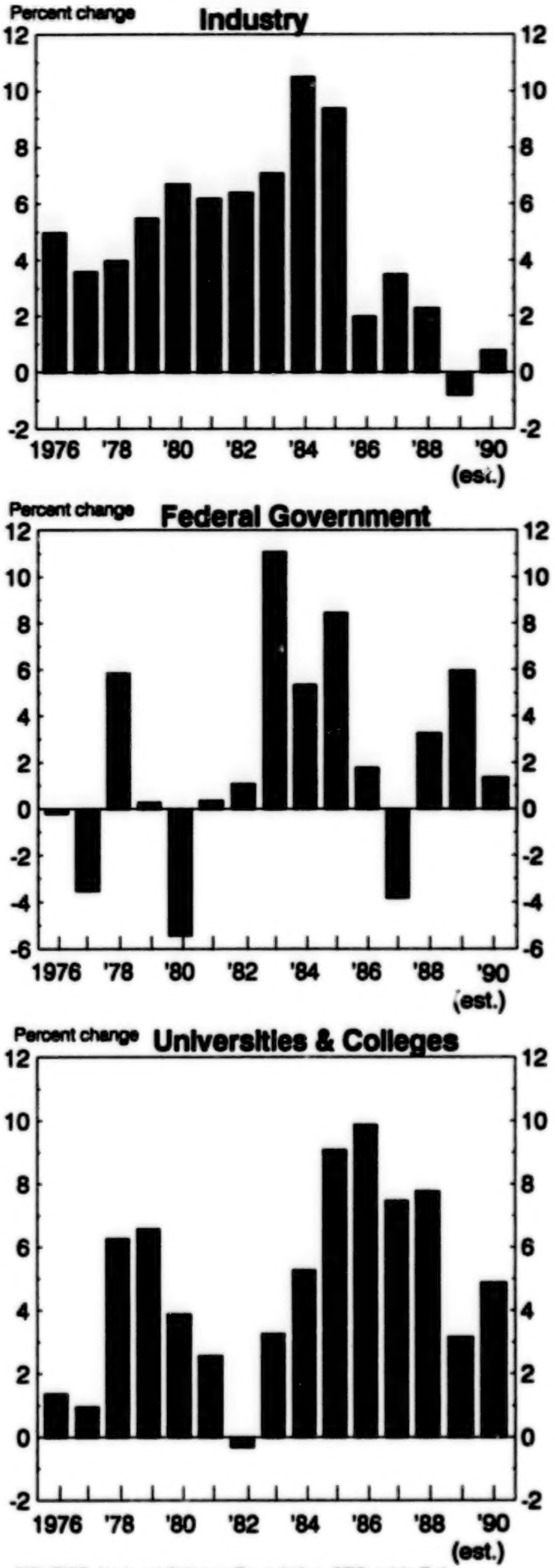
[2] FFRDCs administered by individual universities and colleges and by university consortia.

NOTE: State and local government funds included in industry funds reported to industry performers, and in university and college funds reported to university and college performers.

SOURCE: National Science Foundation, SRS

Chart 10. Changes in national R&D spending by performer

(Based on constant 1982 dollars)



SOURCE: National Science Foundation, SRS; table B-6

sixth of total. Machinery (including computers), motor vehicles, and chemicals companies each accounted for an additional 10 percent or more. As a percentage of net sales, 1988 R&D expenditures (including company and Federal funds) of aircraft and missiles (aerospace) companies were again largest at 15.4 percent; followed by that of electrical equipment companies, 8.1 percent; and companies producing professional and scientific instruments at 7.7 percent. The R&D/net sales ratio for all manufacturing companies that fund R&D was 4.8 percent in 1988 (table B-18).

Federal financing for these industries varied considerably. The Federal Government provided $33 billion for all industry's R&D performance in 1988, and aerospace companies received 60 percent of that. Consequently, three-quarters of the aerospace industry's R&D dollars came from Federal sources and only one-quarter came from non-Federal sources (chart 11). In comparison, the electrical equipment industry financed 67 percent of its R&D from non-Federal funds; the motor vehicles industry funded 77 percent; the machinery industry funded 90 percent; and chemical companies funded 96 percent of its R&D.

federal government

Projections and trends. The Federal Government is expected to perform $17 billion of the 1990 U.S. R&D total. This is a 6-percent increase from estimated 1989 levels, or about 1 percent more after adjusting for inflation. Much of the increase is expected for R&D performance by DOD and NASA. In total, Federal agencies will account for 11 percent of the estimated national R&D performance effort in 1990.

Up until 1980, the Federal Government had been the second largest R&D performer in the Nation. Its share of the national R&D performance total, however, fell from 16 percent in 1970 to 12 percent in 1980. This reduction in Federal R&D performance share was caused primarily by cutbacks in space R&D programs: NASA funds for intramural R&D performance decreased by more than one-half in real terms during this period. As a result, in 1980 the academic sector—including associated FFRDCs—surpassed the Federal Government in terms of national R&D

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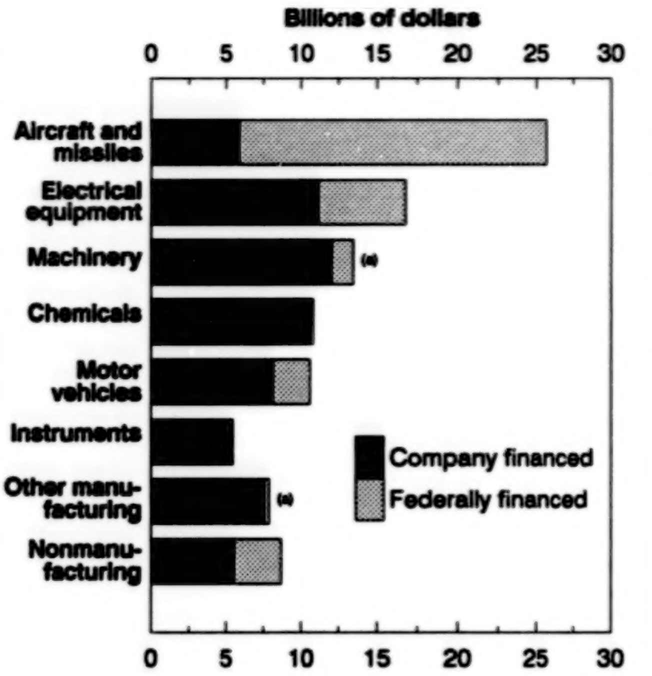
[19] In 1987, nominal spending on Federal intramural R&D actually fell 1 percent (down 4 percent in real terms), reflecting substantial cutbacks in DOD spending. Not since 1955 had Federal intramural R&D performance declined from one year to the next.

Chart 11. Industrial R&D performance by industry and source of funds: 1988



[a] Federally financed R&D estimated from trend data.
SOURCE: National Science Foundation, SRS; tables B-26 and B-27

performance shares. During most of the eighties, the Federal sector dropped to, and annually accounted for, about 11 percent of U.S. R&D performance.[19]

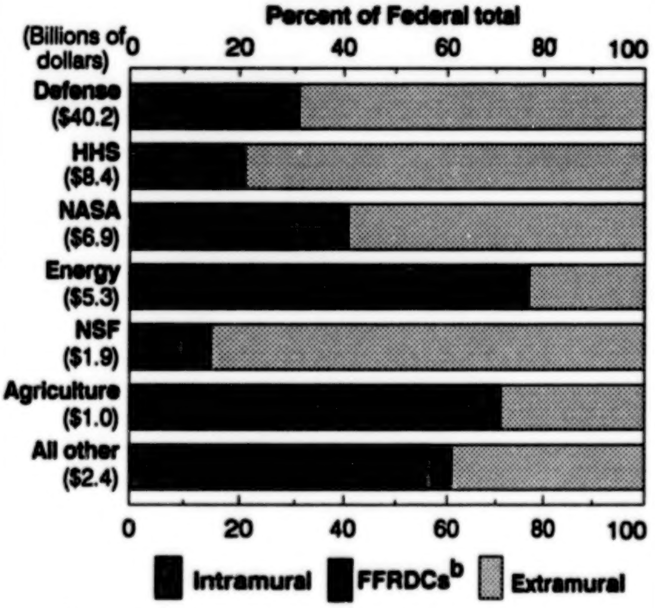
By agency. Including costs associated with planning and administering extramural R&D programs, only three agencies are expected to have intramural R&D expenditures exceeding $1.0 billion in 1990.[20] Intramural R&D performance by DOD is estimated to increase 8 percent to $10 billion. NASA's intramural R&D is expected to grow 13 percent to $2.1 billion, and that by the Department of Health and Human Services (HHS)—mostly for the National Institutes of Health—could rise 3 percent to $1.7 billion. All other Federal agencies are expected to spend a total of $2.5 billion on intramural R&D, representing a 4-percent decrease from 1989 levels.

As a percentage of an agency's total—intramural and extramural—1990 obligations for R&D, intramural performance is estimated to be highest for the Department of Agriculture (71 percent of its $1 billion total), followed by NASA (31 percent of $7 billion), and DOD (26 percent of $40 billion). Intramural performance accounts for an estimated 3 percent of DOE's $5 billion R&D support funds; FFRDCs are expected to receive the bulk (74 percent) of the DOE money (chart 12).

universities and colleges

Universities and colleges (excluding academically administered FFRDCs) account for an estimated 11 percent ($16 billion) of the 1990 national R&D performance effort.

Chart 12. Federal obligations for intramural, FFRDC, and extramural R&D performance by agency: 1990[a]



[a] Based on the Administration's 1990 budget proposal.
[b] Federally funded research and development centers.
NOTE: Intramural activities include costs of administering intramural and extramural programs, as well as actual intramural R&D performance.
SOURCE: National Science Foundation, SRS

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[20] Estimates are for FY 1990 Federal intramural obligations as reported in the Administration's 1990 budget proposal (see the Technical Notes), and cover costs associated with planning and administering intramural and extramural R&D programs by Federal personnel as well as actual intramural R&D performance. See National Science Foundation, *Federal Funds for Research and Development: Fiscal Years 1988, 1989, and 1990*, Volume XXXVIII, Detailed Statistical Tables, NSF 90-306 (Washington, D.C., 1990).

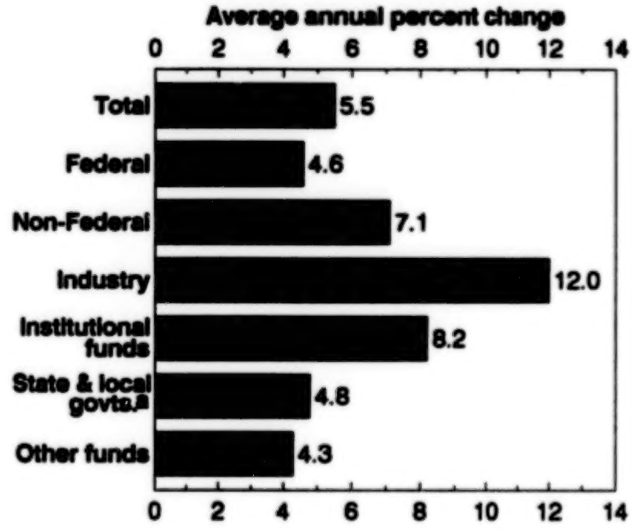
[21] R&D data are for separately-budgeted expenditures only. Consequently, they exclude that portion of salaries for research time or other research expenses financed by funds not specifically earmarked for R&D that come from State and local governments and other non-Federal sources, including endowments.

This represents a 9-percent increase from 1989 levels, or 5 percent growth adjusting for inflation.

Although there was considerable fluctuation in the annual changes, overall R&D performance by the academic sector increased rapidly during the past decade.[21] From 1980 to 1985, real growth averaged 4.0 percent annually. Furthermore, while real increases in the R&D performance of other sectors slowed considerably after 1985, that of universities and colleges quickened to an estimated 6.6-percent average annual rate over the 1985-90 period. This compares with estimated average annual real R&D growth rates of 1.5-percent for industry and 1.7-percent for Federal intramural performers.

The Federal Government provides the major—but declining—share of the R&D funds used by universities and colleges. In the early 1980's, Federal funds accounted for two-thirds of the academic total. By 1990, however, this share had dropped to an estimated 58 percent. Consequently, much of the recent growth in academic R&D performance is attributable to increased funding from non-Federal sources (chart 13).

Chart 13. Growth in university and college R&D performance by source of funds: 1978-88
(Based on constant 1982 dollars)



[a] Excludes general-purpose State or local government appropriations that universities use at their discretion for R&D.

SOURCE: National Science Foundation, SRS

Between 1980 and 1988 (the latest year for which detailed survey data are available), total R&D performance by universities and colleges—exclusive of FFRDCs—increased 55 percent in real terms. Federally financed academic R&D ($8.2 billion in 1988) was up 39 percent; university and college R&D performance using non-Federal funds ($5.2 billion) grew by 87 percent. Most notably, the links between academic institutions and industry expanded considerably. Industry's academic R&D funding increased by 161 percent in real terms from 1980 to 1988, although it still accounted for just 7 percent ($0.9 billion) of academia's 1988 R&D total. Universities' own institutional funds, the largest non-Federal source, were 95 percent larger in real terms, accounting for 17 percent ($2.3 billion) of their separately budgeted 1988 R&D expenditure total. Real R&D funds from State and local governments increased by 60 percent over this 8-year period, and constituted 8 percent ($1.1 billion) of universities' 1988 R&D total.

academically administered ffrdcs

R&D performance in 1990 by university-administered FFRDCs is estimated at $5.3 billion, or almost 4 percent of the national R&D effort. FFRDCs account for one-quarter of total estimated 1990 academic (universities and colleges plus academically administered FFRDCs) R&D performance. Academic R&D accounts for an estimated $21 billion, or 14 percent of the Nation's 1990 R&D performance.

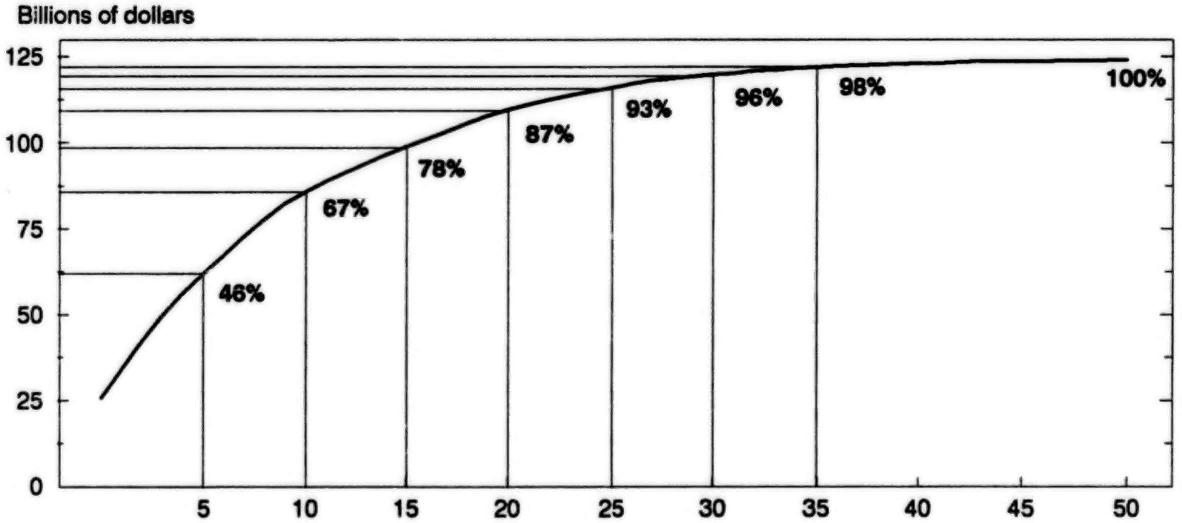
From 1974 to 1980, academically administered FFRDCs increased their R&D performance by 60 percent in real terms. This increase largely mirrored the Federal emphasis on—and funding of—energy programs. Since 1980, the Federal shift from energy to defense has resulted in much slower growth in FFRDC R&D performance, a 50-percent gain in real terms. Their 1980-90 growth rate thus is only one-half the rate of increase reported for the 1974-80 period: 4.1-percent average annual growth versus 8.1 percent.

national r&d performance patterns—by state

The latest data available on the State distribution of R&D expenditures are for 1987. These data cover R&D performance by industry, academia, and Federal and State agencies; and the federally funded R&D activities of nonprofit institutions.[22]

The State distribution of R&D performance is highly concentrated (chart 14). Of the total U.S. R&D dollars spent in 1987—$128 billion—one-half was spent in just six States (California, New York, Michigan, Massachusetts, New Jersey, and Pennsylvania). These States, along with Texas, Illinois, Ohio, and Maryland, accounted for about two-thirds of the national R&D effort.[23] Performance in California alone reached $26 billion (20 percent of the 1987 U.S.

Chart 14. Cummulative distribution of R&D performance by State: 1987



NOTE: Excludes R&D performance in the District of Columbia and R&D expenditures undistributed by State.
SOURCE: National Science Foundation, SRS; table B-16

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[22] R&D performance data include that conducted by FFRDCs located in each sector of the economy. For a more detailed description of these data as well as comparisons of 1985 R&D expenditures with other economic measures (for example, population and gross State product), see National Science Foundation, *Geographic Patterns: R&D in the United States*, NSF 89-317, Report (Washington, D.C., 1989).

[23] These percentage distributions are based only on expenditures that could be allocated by State. For 1987, 2 percent ($2.3 billion) of the U.S. R&D performance total reported in the geographic table B-16—$128 billion—was not distributed by State. The $128 billion R&D total differs slightly from that reported in the R&D trend table B-1 ($127 billion) because of (1) sector-specific revisions captured in table B-1, but not in table B-16, and (2) inclusion of State agencies' intramural R&D performance ($0.4 billion) in table B-16, but not table B-1.

total); R&D expenditures ranged between $4 billion and $9 billion in the other 9 leading States. R&D performance in each of the next 10 States totaled more than $2 billion; when combined with the first 10 States, these collectively accounted for 86 percent of the Nation's R&D in 1987. R&D undertaken in the remaining 30 States and the District of Columbia totaled less than $16 billion, or 13 percent of the R&D conducted nationwide.[24]

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[24] These State rankings are altered somewhat when the R&D expenditures are normalized by size of the State. For example, in 1985 the five States with the largest R&D/gross State product ratios were New Mexico, Delaware, Maryland, Massachusetts, and New Jersey. Only Massachusetts and New Jersey were among the largest five in terms of total in-State R&D performance. (See National Science Foundation, *ibid.)*

Table 3. States Leading in R&D performance by sector: 1987

(Dollars in millions)

Total R&D	Rank	All sectors	Industry	Federal Government	Academia	Other[1]
$25,557	1	California	California	Maryland	California	Massachusetts
8,403	2	New York	Michigan	California	New York	California
7,922	3	Michigan	New York	D.C.	Massachusetts	New York
7,772	4	Massachusetts	New Jersey	Ohio	New Mexico	Virginia
6,728	5	New Jersey	Massachusetts	Virginia	Illinois	D.C.[3]
5,631	6	Pennsylvania	Pennsylvania	Florida	Texas	Pennsylvania
5,462	7	Texas	Illinois	Alabama	Maryland	Washington
5,369	8	Illinois	Texas	Massachusetts	Pennsylvania	Colorado
4,936	9	Ohio	Ohio	New Mexico	Michigan	Illinois
4,609	10	Maryland	Washington	Texas	Ohio	Texas
3,523	11	Washington	Minnesota	Pennsylvania	Georgia	Ohio
3,123	12	Florida	Connecticut	New Jersey	New Jersey	Minnesota
2,561	13	Virginia	Florida	Rhode Island	North Carolina	Maryland[3]
2,533	14	Minnesota	Indiana	New York	Wisconsin	North Carolina
2,474	15	Connecticut	Missouri	Colorado	Florida	Alabama
2,388	16	New Mexico	North Carolina	North Carolina	Colorado	Michigan
2,352	17	Alabama	Alabama	Mississippi	Washington	Florida
2,219	18	North Carolina	Maryland	Tennessee	Connecticut	South Carolina
2,197	19	Indiana	Virginia	Washington	Minnesota	Oklahoma
2,174	20	Missouri	Colorado	Utah	Missouri	Oregon
1,705	21	Colorado	Wisconsin	Georgia	Arizona	Missouri
1,549	22	Wisconsin	Kansas	Michigan	Virginia	Maine
1,505[2]	23	D.C.[2]	Georgia	Arizona	Indiana	Rhode Island
1,429	24	Georgia	New Mexico	Nevada	Iowa	Alaska
1,288	25	Kansas	Delaware[2]	Illinois	Alabama	Tennessee
1,145	26	Arizona	Arizona	Indiana	Tennessee	New Mexico
1,034	27	Utah	Utah	West Virginia	Louisiana	Arizona
957[2]	28	Delaware[2]	Tennessee	Missouri	Oregon	New Jersey
941	29	Tennessee	South Carolina	Louisiana	Utah	Connecticut
649	30	South Carolina	Idaho	Oklahoma	Oklahoma	Georgia
554	31	Rhode Island	Oklahoma	Alaska	South Carolina	Wisconsin
540	32	Iowa	Iowa	Oregon	Kansas	Wyoming
534	33	Oklahoma	Oregon	Kentucky	D.C.	Nevada
532	34	Idaho	Kentucky	Minnesota	Kentucky	Kansas
474	35	Oregon	Vermont	Arkansas	Nebraska	Hawaii
356	36	Kentucky	Rhode Island	Hawaii	Rhode Island	Mississippi[3]
321	37	Louisiana	Arkansas	Nebraska	Mississippi	Utah
283	38	Vermont	Louisiana	Wisconsin	Hawaii	Idaho
234	39	Mississippi	D.C.[2]	North Dakota	New Hampshire	Louisiana
196	40	Arkansas	New Hampshire	Iowa	West Virginia	Delaware
188	41	West Virginia	West Virginia	New Hampshire	North Dakota	Nebraska
168	42	Nevada	Hawaii	Montana	Arkansas	Kentucky
161	43	New Hampshire	Nebraska	Connecticut	Delaware	Arkansas
159	44	Hawaii	North Dakota	Idaho	Vermont	South Dakota
158	45	Nebraska	Nevada	South Carolina	Alaska	Indiana
120	46	North Dakota	Mississippi	Kansas	Montana	North Dakota
86	47	Alaska	Maine	Wyoming	Nevada	West Virginia
79	48	Maine	Alaska	South Dakota	Idaho	Iowa
55	49	Montana	Montana	Maine	Wyoming	Vermont
36	50	Wyoming	South Dakota	Vermont	Maine	Montana
23	51	South Dakota	Wyoming	Delaware	South Dakota	New Hampshire

[1] Rankings are based on State Government performance and Federal obligations to nonprofit institutions.
[2] Based on midpoint of possible R&D performance range. See table B-16.
[3] Based only on Federal obligations to nonprofit institutions.
SOURCE: National Science Foundation, SRS.

Each of the 10 States that ranked highest in terms of 1987 R&D performance was also among the top 10 in 1977: Their exact rankings, however, shifted slightly. The largest three (California, New York, and Michigan) were unchanged from 1977, as was New Jersey (ranked fifth in both years). Massachusetts and Pennsylvania changed positions—fourth and sixth, respectively, in 1987—during this 10-year period. Texas moved from tenth in 1977 to seventh in 1987, while Illinois, Ohio, and Maryland were ranked one position lower in 1987 relative to 1977 rankings.

Not coincidentally, most of the States that are national leaders in total R&D performance are also leading R&D performers in one or more economic sectors (table 3). For example, of the 10 States that led in total 1987 R&D performance, only Maryland was not ranked among the top 10 industrial performers and only New Jersey was not ranked among the top 10 academic performers. California and New York were ranked among the top three States in each of the industry, academic, and nonprofit sectors.

State rankings for Federal intramural R&D performance vary somewhat from the other sector rankings. Four States—Virginia, Alabama, Florida, and New Mexico—and Washington, D.C., were ranked among the 10 Federal sector leaders in 1987, even though they were not listed among the total R&D top 10. Each, however, was ranked among the top one-half in terms of total in-State R&D performance.

character of work

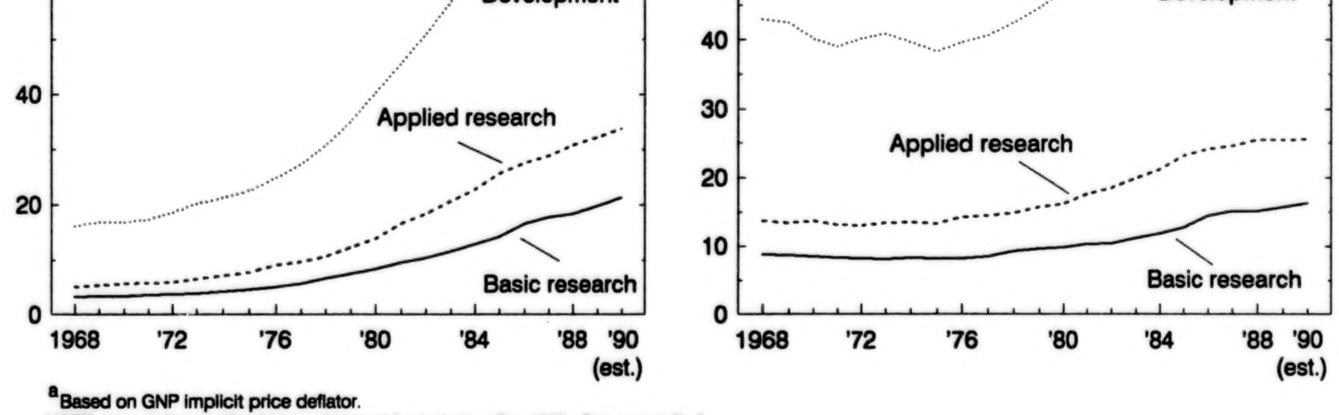
The Nation is expected to spend $21 billion on basic research (or 14 percent of the R&D total) in 1990, $34 billion on applied research (23 percent of total), and $95 billion on development (63 percent of total) (chart 15). These totals represent increases from estimated 1989 levels of 8 percent for basic research (4 percent in real terms), and roughly 5 percent each for applied research and development (0.4 percent and 1 percent, respectively, after inflation).

In 1980, the respective shares of the U.S. R&D total were approximately 13 percent basic research, 22 percent applied research, and 64 percent development. The methodology for imputing character-of-work estimates for industry's R&D performance, however, was changed for 1986 and later years. The revised approach resulted in relatively higher estimates for basic and applied research, and lower estimates for development expenditures. Consequently, these data are not strictly comparable to data for 1985 and earlier years. (See appendix A for further details.)

basic research

The average annual growth in basic research spending between 1986 and 1990 is estimated at 6.7 percent. After adjusting for inflation, this represents an annual increase of 2.9 percent per year, which is somewhat slower than the 5.2-percent real rate of growth reported for the years 1980 to 1985. (The change between 1985 and 1986 is ignored here since it largely is an artifact of the revised imputation

Chart 15. National R&D spending by character of work



Year	Average annual rate of change		
	Basic	Applied	Development
1968-75	5.3%	6.2%	4.9%
1975-85	11.6	12.5	12.5
1986-90	6.7	5.2	5.8
1989-90	8.1	4.6	5.4

Year	Average annual rate of change		
	Basic	Applied	Development
1968-75	-1.1%	-0.4%	-1.6%
1975-85	4.5	5.7	5.6
1986-90	2.9	1.4	1.9
1989-90	3.7	0.4	1.2

[a] Based on GNP implicit price deflator.

NOTE: Imputation methodology changed for industry after 1985. See appendix A.

SOURCE: National Science Foundation, SRS; tables B-7, B-9, and B-11 procedures noted above. Of course, the differential growth rates between the two periods also might be such an artifact.)

In terms of support, the Federal Government provides the majority of funds used for basic research. Yet as a share of the national basic research total, Federal support dropped from 70 percent in 1980 to an estimated 62 percent ($13 billion) in 1990. This decline does not necessarily indicate a diminution in Federal support for basic research (in fact, it is up 44 percent in real terms since 1980), but rather reflects the growing tendency for such support to come from other sectors (up 112 percent over the 10-year period).

In terms of performance, universities and colleges account for the largest share (49 percent) of the basic research total. Including that of university-administered FFRDCs, the academic sector's share of total climbs to 62 percent. In 1990, universities'—net of FFRDCs—basic research performance is expected to reach $11 billion; this represents a 10-percent increase from 1989 (6 percent in real terms). The Federal Government—primarily NIH and NSF—is expected to provide 58 percent of the basic research funds used by universities and colleges in 1990; non-Federal sources, including industry and State Governments, will provide 42 percent of the total.

applied research

Over the 1986-90 period, national applied research spending grew at an estimated average annual real rate of 1.4 percent. Increases in industrial support are responsible for most of this gain. Industry accounts for an estimated 55 percent of the 1990 applied research total; Federal support is estimated to account for 38 percent of the Nation's support for applied research.

Seventy percent ($24 billion) of the Nation's applied research is performed within industrial laboratories. Non-Federal sources account for most ($18 billion) of these monies; Federal sources will provide the rest of the funds ($5.7 billion) for industry's estimated 1990 applied research performance.

Of the Nation's non-industrial 1990 applied research performance, most is expected to be conducted by universities and colleges ($4.4 billion) and the Federal Government ($3.6 billion). Until recently, the Federal Government was the Nation's second largest performer of applied research. Since 1976, however, this sector's performance has diminished by 20 percent in real terms. Initially, the decline was mainly a result of cutbacks at NASA where applied research spending decreased by 60 percent (after adjustment for inflation) between 1976 and 1984. Since then, real reductions in DOD's intramural applied research have accounted for most of the Federal loss.

development

Although growth in the Nation's support for development was strong throughout the eighties, it was particularly so in the early half of the decade. From 1980 to 1985, development grew on average by 7.1 percent per year in real terms as increasingly larger shares of the national R&D effort were directed toward defense R&D, which is 90 percent development. Between 1986 and 1990, the estimated average annual real growth rate subsequently fell to 1.9 percent. Growth in both industry's and the Federal Government's development support slowed considerably—the latter reflecting the fiscal constraints placed on overall defense spending. Of the 1990 national spending on development, industry is expected to provide 54 percent of the total and the Federal Government 45 percent.

In terms of performance, industry is estimated to account for 85 percent ($80 billion) of the Nation's 1990 development activities. Such expenditures are concentrated in six major R&D-performing industries—electrical equipment, machinery (including computers), chemicals and allied products, motor vehicles, professional and scientific equipment, and aircraft and missiles.

r&d scientists and engineers

NSF sponsors a variety of surveys designed to collect data on human resources devoted to science and technology in the United States, including information on worker inputs for R&D. Surveys directed at employers or institutions focus on the amount of time devoted to the performance and management of R&D. These data are reported in terms of person-years, or full-time equivalent R&D jobs. Surveys directed at individuals collect data on the self-reported primary work activity; that is, the activity on which one spends the largest proportion of time, but not necessarily full time. These concepts are further described in Appendix A.

surveys of institutions

It is estimated that the full-time equivalent of 949,200 scientists and engineers were employed in 1988 on R&D activities in the United States. This was an increase of about 3 percent over the previous year's level of 923,300; it was a 62-percent increase over the 1978 figure (table B-15).[25] In 1988, three-quarters of these personnel were employed by industry. Universities and colleges and the Federal Government employed most of the rest, 14 percent and 7 percent, respectively.

Throughout the midseventies, there were approximately 55 were FTE R&D scientists or engineers for every 10,000 persons in the labor force. Continued increases in national R&D funding caused this ratio to climb annually to the current ratio of 77 per 10,000.

These personnel estimates make it possible to gain perspective on the changing cost of doing research. In 1988, the Nation—and industry in particular—spent on average about $140,000 on R&D per FTE R&D scientist and engineer. R&D expenditures include salaries, fringe benefits, materials, supplies, and overhead. The comparable 1978 R&D expenditure/FTE R&D personnel ratio was about $80,000 per person.

surveys of individuals

In 1987—the latest year of available data—there were 419,118 doctoral scientists and engineers employed in the United States. This represented a 47-percent increase over the 285,055 total reported for 1977. Employment of doctoral engineers increased slightly more rapidly than did that of doctoral scientists over this 10-year period (4.2 percent versus 3.9 percent annually). Nonetheless, scientists with doctorates outnumbered doctoral engineers by 5 to 1 in 1987.

Many of these doctorate-holders reported R&D as their primary work activity. Specifically, basic research accounted for 15 percent of 1987 work total; applied research accounted for 17 percent; development, 5 percent; and R&D management, 8 percent. Teaching accounted for 27 percent of their primary work activities; the remaining 28 percent was distributed among non-R&D management, consulting, production, and other activities.

As a percentage of the individual totals, scientists (17 percent) were more likely to be engaged in basic research activities than were engineers (5 percent), whereas engineers (39 percent) were more often employed in applied research and development than were scientists (19 percent). Overall, a relatively larger share (60 percent) of doctoral engineers reported R&D or R&D management as their primary work activity than did doctorate-holding scientists (42 percent) (chart 16).

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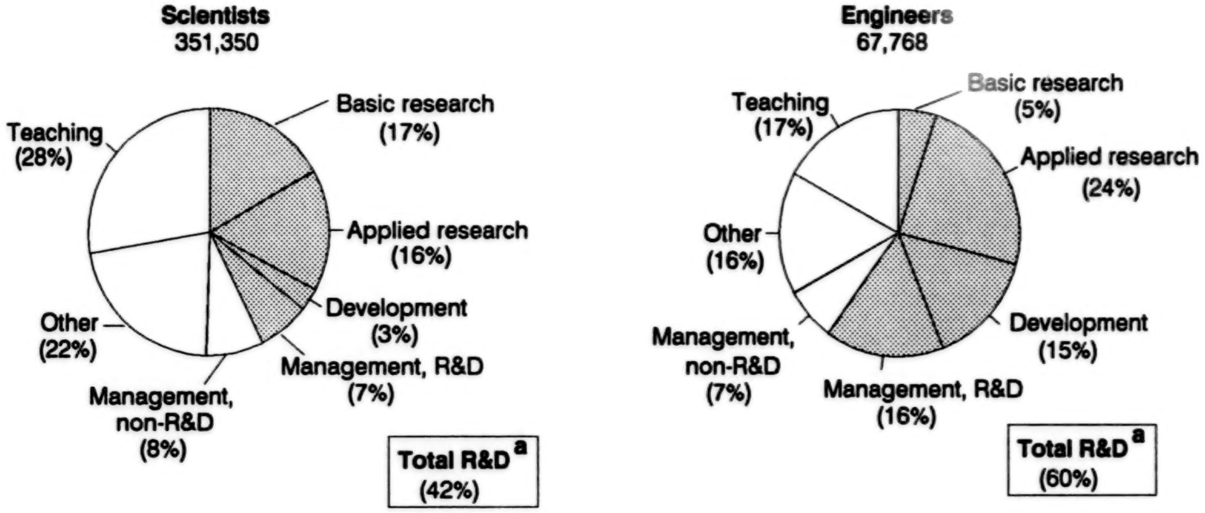
[25] Personnel data for the academic sector—since 1985—and the nonprofit sector—since 1973—have been estimated. The reader should refer to table B-16 for details on the FTE R&D scientists and engineers series.

Chart 16. Distribution of employed doctoral scientists and engineers by primary work activity: 1987



[a] Includes R&D personnel engaged in basic, applied, development, and R&D management activities.

NOTE: Because of rounding, detail may not add to 100 percent.

SOURCE: National Science Foundation, SRS

appendixes:

a. technical notes
b. detailed statistical tables

appendix a

technical notes

basis for sector classification

NSF follows a four-sector division in reporting R&D funds and personnel and maintaining time-series data on expenditures and employment. The sectors are (1) industry, (2) the Federal Government, (3) universities and colleges, and (4) other nonprofit organizations. Information also is collected for federally funded research and development centers (FFRDCs), which are organizations exclusively or substantially financed by the Federal Government to meet a particular requirement or to provide major facilities for research and associated training purposes. Each center is administered either by an industrial firm, an individual university, a university consortia, or a nonprofit institution.

Federal Government. This sector consists of the agencies of the Federal Government.

Industry. This sector consists of both manufacturing and nonmanufacturing companies. Manufacturing companies are reported by major industry groupings. Nonmanufacturing companies are treated as a unit and include those in mining, construction, transportation, communications, and selected services industries such as R&D laboratories and computer and data processing services. Performance of FFRDCs administered by industrial firms is included in industry totals. Industry's funding of industry R&D includes all funds (e.g., from State and local governments) other than those received from Federal sources.

Universities and colleges. This sector consists of all institutions of higher education, both public and private. Expenditures of FFRDCs administered by universities and colleges are reported separately from totals for this sector. University funding of university R&D includes (1) State and local government funds separately budgeted for R&D, and (2) restricted or general funds that the institutions themselves have been free to allocate for research. Funds from the Federal Government, industry, or other nonprofit institutions, which are supplied in the form of grants or contracts for R&D at a university, are credited to the appropriate source. For example, research contracts from industry are treated as university performance funded by industry as the source. Funds given to the institution by industry for general educational purposes and used by the school—at its discretion—for research are treated as university performance financed with the university's own funds.

Other nonprofit institutions. This sector consists of institutions that fall into two general groups: (1) Organizations that are primarily granting in nature, namely, private philanthropic foundations and voluntary health agencies; and (2) public and private organizations that are involved in performing R&D, including FFRDCs administered by nonprofit organizations.

definitions

Research and development in this report consists of basic and applied research in the sciences (including medical sciences) and in engineering and activities in development, all defined below.

The Federal, university, and nonprofit sectors report data for the broad fields of life sciences, physical sciences, environmental sciences, mathematics and computer sciences, psychology, physical sciences, engineering, social sciences, and an all-inclusive other sciences category. Industry coverage is limited to (1) the physical sciences, including related engineering; and (2) the biological sciences, including medicine but excluding psychology. It specifically excludes research in the social sciences.

Basic research. Within the Federal, university, and nonprofit sectors, basic research is defined as research directed toward increases in knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific application toward processes or products in mind. For the industry sector, basic research projects are defined as "original investigations for the advancement of scientific knowledge... which do not have specific commercial objectives, although they may be in fields of present or potential interest to the reporting company."

Applied research. Within the Federal, university, and nonprofit sectors, applied research is defined as research directed toward gaining "...knowledge or understanding necessary for determining the means by which a recognized and specific need may be met." Here again, the applied research definition for the industry sector is modified to include "...research projects which represent investigations directed to discovery of new scientific knowledge and which have specific commercial objectives with respect to either products or processes."

Development. The NSF survey definition of development is "...the systematic use of the knowledge or understanding gained from research directed toward the production of useful materials, devices, systems or methods, including design and development of prototypes and processes." It excludes quality control, routine product testing, and production.

current operating costs

Funds used for R&D refer to current operating costs. They consist of both direct and indirect costs; they include not only salaries, but also fringe benefits, materials, supplies, and overhead. The R&D costs include depreciation, insofar as this information is available to respondents. Capital expenditures are excluded by definition in the surveys of industry and the universities and colleges sector. Under the accounting practices of some Federal agencies, obligations for capital items may be included.

For universities and colleges, R&D data are for separately-budgeted expenditures only. Consequently, they exclude that portion of salaries for research time or other research expenses financed by funds not specifically earmarked for R&D that come from State and local governments and other non-Federal sources, including endowments.

performer-reporting basis

NSF sponsors a series of surveys to collect information on the financial and human resources devoted to research and development in the various sectors of the U.S. economy (defined above). Although these surveys are not designed specifically for this purpose, they are the primary source material for estimating the national R&D totals. Respondents indicate the amounts they spend on R&D in their own sector and, generally, the sources of these funds. To the greatest extent possible, national totals are based on data as reported by performers because they are in the best position to (1) indicate how much they spent in the actual conduct of R&D in a given year; (2) classify their work as basic, applied, etc.; and (3) identify the sector of the economy in which their financing originated. The consistent use of performer reporting also reduces the possibility of double-counting.

Separate R&D performance totals are reported for (1) the Federal Government, (2) industry, (3) universities and colleges, (4) university-administered FFRDCs, and (5) other nonprofit organizations. R&D performed by State and local government agencies is not included in the national R&D totals. When State and local governments are listed by a survey respondent as the source of non-Federal R&D funds, those amounts are included in the source totals of the sector reporting the R&D performance.

Federal Government. Federal agency R&D obligations for intramural performance are treated as the equivalent of R&D expenditures in the *National Patterns*. Such intramural activities cover costs associated with the planning and administration by Federal personnel of intramural and extramural R&D programs as well as actual intramural R&D performance. (See specifically, *Federal Funds for Research and Development: Fiscal Years 1988, 1989, and 1990 (Federal Funds)*, NSF 90-306.) In general, the universe of Federal agencies with R&D programs has been surveyed annually since 1953 for their R&D performance, and since 1963 for the distribution by character of work. The most recent survey included R&D funding as reported by 96 Federal agencies.

In addition to Federal obligation data, *National Patterns* utilizes data on Federal R&D budget authority and outlays. The use of each series is clearly noted in the text.

- **Budget authority** is the primary source of legal authorization to enter into obligations that will result in outlays. Budget authority most commonly is granted in the form of appropriations laws enacted by Congress with the approval of the President. (See *Federal R&D Funding by Budget Function: Fiscal Years 1989-91 (Budget Function)*, NSF 90-311.)
- **Obligations** represent the amounts for orders placed, contracts awarded, services received, and similar transactions during a given period, regardless of when the funds were appropriated and when future payment of money is required.
- **Outlays** represent the amounts for checks issued and cash payments made during a given period, regardless of when the funds were appropriated or obligated.

Industry. In general, the industry sector has been surveyed annually since 1953 for its total R&D performance, and since 1956 for the distribution by character of work. The U.S. Bureau of the Census conducts the survey for NSF. The target population of the survey is companies, whether American- or foreign-owned, that perform R&D in the United States. A new sample is drawn and canvassed every 5 or 6 years (for example, in 1976, 1981, and 1987). In the intervening years, a subset of the last sample—called a panel and including all companies reporting more than $1 million in R&D—is surveyed. Accordingly, data for the years in which a sample is not drawn do not include companies that are new entrants in the R&D field, and may be biased in a downward direction. Census, however, estimates the annual changes in R&D data for companies that report R&D in the sample year but are not included in the panel. As new samples are drawn, revisions to previous estimates are issued.

In 1988, the panel consisted of approximately 1,700 companies selected from the 1987 sample and represented an estimated 92 percent of total industry-performed R&D. Details on survey methods, coverage, concepts, definitions, and reliability of the estimates associated with the R&D expenditure data are contained in *Research and Development in Industry: 1987 (Industry R&D)*, NSF 89-323, and in the forthcoming *Industry R&D: 1988* report.

A new sample was drawn for 1987, from which R&D data were collected for 1986 as well as 1987. Data from the new sample were used by Census to revise 1986 R&D performance estimates. The new 1986 data were also used by Census in combination with data from the last sample year, 1981, to revise estimates for the intervening years. NSF subsequently provided a second round of revisions to the 1982-85 R&D series. In both cases, the revisions were done on an industry basis: an effort was made to apply the overall 1981-86 growth rates while preserving the relative year-to-year movements in each industry's R&D. This approach resulted in major revisions of the 1982-87 industry R&D time series previously published in *National Patterns*, especially of the nonfederally funded component of industry's R&D performance. The revised totals, as well as the industry data reported in previous *National Patterns* (NSF 89-308), are presented in table A-1.

[Note that although Census re-estimated 1982-86 R&D totals by funding source, it did not provide a character-of-work distribution for the revised data. After investigating several possible alternatives, NSF chose to allocate the revisions (table A-1) on the basis of average character-of-work distribution published in earlier annual *Industry R&D* reports. Allocations for the federally funded and nonfederally funded R&D revisions were applied separately.]

Additionally, the procedures used by the Bureau of the Census for imputing character-of-work splits for industry's R&D performance have been changed for 1986 and later years; hence, these data are not directly comparable to data for 1985 and earlier years. A full description of the various imputation methodologies—and alternatives—is presented in the forthcoming *Industry R&D: 1988* and in an accompanying *Technical Report*. Briefly, however, for 1985 and earlier, for companies that did not report character-of-work splits, Census imputed the splits based on either (1) the company's percentage distribution reported in its most recent year of available data, or (2) in the absence of any prior year breakdown for the company, the average character-of-work split for the industry to which the company was assigned. For years after 1985, Census does not impute a company's character-of-work distribution unless the company has reported a breakout within two years of the year being imputed. When distributions are not imputed, Census assigns the company's R&D to an "undistributed residual" category. (For example, and as detailed in table A-2, of the $66 billion reported industry 1988 R&D performance with non-Federal funds, Census did not distribute $21 billion.)

To provide estimates for this *National Patterns*, NSF dis-

Table A-1. Revisions in industry R&D performance
[Dollars in millions]

	Total R&D			Non-federal R&D funds			Federal R&D funds		
	Previously Reported	Revision	Revised Totals	Previously Reported	Revision	Revised Totals	Previously Reported	Revision	Revised Totals
1982	57,995	655	58,650	39,512	593	40,105	18,483	62	18,545
1983	63,403	1,865	65,268	42,861	1,727	44,588	20,542	13	820,680
1984	71,470	3,330	74,800	48,308	3,096	51,404	33,162	234	23,396
1985	78,269	5,970	84,239	51,439	5,604	57,043	26,830	366	27,196
1986	80,631	7,548	88,179	52,848	7,084	59,932	27,783	464	28,247
1987	85,500	8,617	94,117	55,500	7,306	62,806	30,000	1,311	31,311

tributed each industry's "undistributed residual" based on the average character-of-work split reported for that industry. This approach resulted in relatively higher performance shares for basic and applied research than had been previously estimated, and relatively lower estimates for development's share of industry's total R&D performance (table A-2). NSF will be issuing a special *Technical Report* to explain the uncertainties in the data and to quantify their sensitivity to the choice of various possible imputation procedures.

Universities and colleges. The university and college sector, including all university-administered FFRDCs, has been surveyed annually since 1972 for R&D performance. Prior to 1972, the academic sector was surveyed less frequently. For 1988, data were collected from a full population of 556 institutions of higher education in the United States and outlying areas that (1) granted a graduate degree in science or engineering and/or (2) performed activities for which at least $50,000 has been funded from separately budgeted R&D expenditures. For 1983 through 1987, R&D performance was estimated from a census of institutions that granted doctorates in science and engineering, plus a sample of all other universities and colleges.

Table A-2. Distribution of industry R&D performance by character of work

[Dollars in millions]

Non-federal funds

Census imputation

	Total R&D	Basic research	Applied research	Development	Undistributed residual
1985	57,043	2,140	11,640	37,659	5,604
1986	59,932	2,162	9,914	29,081	18,775
1987	62,806	2,083	10,230	30,077	20,416
1988	66,463	2,096	10,933	32,259	21,175

Reported in current National Patterns

	Total R&D	Basic research	Applied research	Development
1985	57,043	2,373	12,908	41,762
1986	59,932	3,496	15,082	41,354
1987	62,806	3,392	15,734	43,680
1988	66,463	3,355	16,599	46,509

Federal funds

Census imputation

	Total R&D	Basic research	Applied research	Development	Undistributed residual
1985	27,196	482	5,275	21,073	366
1986	28,247	370	3,444	17,074	7,359
1987	31,311	506	3,516	18,773	8,516
1988	32,959	414	3,752	20,187	8,606

Reported in current National Patterns

	Total R&D	Basic research	Applied research	Development
1985	27,196	489	5,347	21,360
1986	28,247	550	4,659	23,038
1987	31,311	757	4,937	25,617
1988	32,959	633	5,269	27,057

With the exception of 1978, data on the basic research performance of universities and colleges and of university-administered FFRDCs have been collected annually since 1972. Since 1979, however, only the combined total for applied research and development performance has been collected. Furthermore, data on the character of work from individual non-Federal sources of funds (i.e., industry, institutional funds, State and local governments, and other sources) are not surveyed. For the years 1979 to the present, the distribution of applied research and development from Federal sources is based largely on data from *Federal Funds;* the development split from *each* of the non-federal funding sources is estimated at 7 percent of the surveyed non-Federal R&D funding totals; and the applied research share from *each* of the non-Federal funding sources is an estimated residual (total R&D funds, minus basic research funds, minus development funds).

For the academic sector alone, R&D performance includes research funds subcontracted to outside organizations. For performance reported by respondents in the other surveyed sectors, R&D subcontracted to other organizations is excluded. Details on survey methods, coverage, concepts, definitions, and reliability of the estimates associated with the R&D expenditure data are contained in *Academic Science/Engineering: R&D Funds: Fiscal Year 1988 (Academic R&D)*, NSF 89-326.

Other nonprofit institutions. It has not been possible to maintain the same survey frequency for other nonprofit institutions; the last complete survey was conducted in 1973. Since then, small and informal surveys of this sector have been undertaken periodically, most recently for 1983. For the years 1984 to the present, estimates for federally-funded total R&D and character-of-work performance by nonprofit institutions—including associated FFRDCs—are derived from Federal obligation data reported in *Federal Funds.* Industry as a source of R&D funds to this sector is estimated from the average of the annual percent change in (1) industry's funding of industry-performed R&D (from *Industry R&D)* and (2) industry funding of university-performed R&D (from *Academic R&D*). Nonprofits as a source of R&D funds to this sector is estimated from the annual percent change in nonprofit funding of university-performed R&D (from *Academic R&D*). The character-of-work splits from the non-Federal funding sources that were surveyed in 1983 are carried forward to the present.

use of time-series data

Data presented in trend tables are assembled from the most recently completed survey cycles. Data for prior years are reviewed for consistency with current year's responses and, when necessary, revised in consultation with survey respondents. In addition, changes in sample design or imputation methodologies can result in revisions to previously published data. (The impact from one recent example of such revisions is detailed in the foregoing *industry* discussion.) For trend comparisons, the reader therefore is strongly encouraged to use the historical data contained in this current report, rather than the data published in previous volumes of the *National Patterns*.

defense-space-civilian classification

Defense R&D consists of R&D spending by DOD and defense-related atomic energy programs of DOE. All DOD activities are classified as defense, although some activities have secondary objectives (for example, space). Space R&D consists of R&D spending by NASA alone. All industry-funded R&D is classified as civilian R&D, including expenditures by aerospace and electronic industries.

This report contains data on (1) the estimated percentage distribution of total U.S. R&D performance by national objective (table B-13), and (2) the reported distribution of Federal R&D authority by budget function (table B-21), *Federal R&D Funding by Budget Function: Fiscal Years 1989-91 (Budget Function)*, NSF 90-311. The performer-based U.S. shares differ from the Federal budget authority shares for several reasons. The U.S. shares are based on expenditures reported by performers, who often expend Federal R&D funds in a year other than the one in which the Federal Government provided authorization, obligations, or outlays. In addition, the two series are based on slightly different concepts. For example, whereas in the U.S. series, all of NASA's R&D funds are considered to be expenditures for space R&D, the budget authority data are distributed according to the functional categories that constitute the Federal budget; hence, NASA's R&D budget authorizations are distributed between the space research and technology function and the transportation function.

estimating procedure for 1989 and 1990

To the greatest extent possible, this report incorporates data for 1989 and 1990 R&D programs that are presented in the Administration's 1991 budget proposal. For example, the 1991 budget contains data on total R&D outlays and budget authority by agency. Similar detail, however, is not contained in the budget for each character of work. Furthermore, the budget does not contain estimates on the amount of Federal R&D funds received by each of the R&D-performing economic sectors. This information is obtained from an NSF survey of Federal agencies' R&D obligations, which is collected after the President's proposed budget has been published. For this reason, some of the 1989 and 1990 Federal R&D data reported here are based on the Administration's 1990 budget proposal.

R&D performance totals in the *National Patterns* are estimated for each sector, by character of work, and by source of funds from surveys and time series extrapolation techniques:

Federal Government. Estimates are based on changes in intramural R&D obligations reported in *Federal Funds* (NSF 90-306). *Federal Funds* 1989 data reflect congressional appropriations, apportionment, and reprogramming decisions as of the third quarter of FY 1989. For the previously stated reasons, the 1990 data reflect estimates for R&D programs contained in the Administration's 1990 budget proposal.

Industry. Estimates are based on (1) time series modeling for the Federal sector as a source of funds, supplemented by Federal obligations data reported in *Federal Funds* (NSF 90-306), and (2) mail/interview responses to an annual NSF inquiry of its Industrial Panel on Science and Technology, which consists primarily of R&D officials in the major R&D-performing industries. Responses were received from 72 of 83 company officials contacted from April through September 1989 and included 17 of the top 20 R&D-performing companies in the United States (National Science Foundation, "Slow R&D Spending Growth Continues into 1990s," *Science Resources Studies Highlights* (NSF 90-307), March 9, 1990).

Universities and colleges. Estimates are based on (1) Federal obligations reported in *Federal Funds* (NSF 90-306), and (2) extrapolations of recent trends for each of the non-Federal sources.

Other nonprofit institutions. Estimates are based on (1) Federal obligations reported in *Federal Funds* (NSF 90-306), and (2) extrapolations of recent trends in R&D performance and funding within the industry and university sectors, as outlined in the preceding discussion on the *performer-reporting basis*.

geographic distribution

This report contains information on the State distribution of R&D performance for 1987 (table B-16). These data cover R&D performance by industry, academia, Federal and State agencies, and the federally funded R&D activities of nonprofit institutions. The zero figures reported for some States in table B-16 represent R&D performance of less than $0.5 million. These State-distributed data are meant to be indicative of general distribution patterns; they are not necessarily precise.

State-distributed data for the industry sector are collected only for odd-numbered years. Hence the latest available detailed data are for 1987 from *Industry R&D* (NSF 89-323). The data include R&D performance by industry-administered FFRDCs.

State-distributed data for Federal laboratories are intramural R&D obligations in FY 1987. These data are available from the 10 major R&D-supporting agencies *(Federal Funds).*

State-distributed data for the university and college sector are collected only for doctorate-granting institutions and university-administered FFRDCs *(Academic R&D).* R&D performance by an FFRDC is assigned to the State where the FFRDC is located, which is not necessarily the State in which the administering institution is located.

State-distributed data for other nonprofit institutions are Federal R&D obligations to this sector in FY 1987 as reported by the 10 major R&D-supporting Government agencies *(Federal Funds).* These agencies provided more than 97 percent of total Federal R&D obligations in 1987. Data on R&D performance by this sector using non-Federal sources of funds are not collected.

State agencies' intramural R&D performance was obtained from a special NSF survey, *Research and Development Expenditures of State Government Agencies: Fiscal Years 1987 and 1988* (NSF 90-309).

human resources

A variety of surveys and estimation techniques are used to gather information on the numbers and characteristics of persons engaged in science and engineering (S/E) activities in all sectors of the economy. In general, two types of surveys are used in reporting worker inputs for R&D: Surveys directed at employers and surveys directed at individuals.

Surveys of individuals (in this report, of scientists and engineers holding doctorate degrees) result in data on the primary work activities and demographic and economic characteristics of the respondents. In the survey of doctoral scientists and engineers, respondents are asked to report their primary work activity; that is, the activity on which the spend the largest proportion of their time, but not necessarily full time. This survey is conducted only in odd-numbered years. Hence the latest tabulated data are available for 1987. Details on survey methods, coverage, concepts, definitions, and reliability of the estimates associated with S/E personnel data are contained in *Characteristics of Doctoral Scientists and Engineers in the United States: 1987* (NSF 88-331).

Surveys of employers are focused on the amount of time--in terms of person-years—devoted to the performance and management of R&D. In this report, data on the number of scientists and engineers—not just those holding doctoral degrees—employed on an FTE basis in R&D are summarized in table B-15. For example, if each of two scientists/engineers spends 50 percent of the workday on R&D, the equivalent is one FTE R&D job. Surveys of employers in the several sectors are as follows: (1) Industry FTE R&D manpower survey data are collected annually *(Industry R&D).* (2) For the Federal sector, survey data on civilian scientists and engineers are collected annually, *Federal Scientists and Engineers* (NSF 89-322); and military personnel data are collected—from individuals—biennially, *U.S. Scientists and Engineers* (NSF 88-322). Data on Federal scientists and engineers are numbers of individuals, not adjusted for full-time equivalence. (3) Unpublished data on full-time S/E graduate students with research assistantships are collected annually by NSF. (4) The last FTE R&D manpower survey of the academic sector was for 1985. (5) The last manpower survey of the nonprofit sector was for 1973, although a small telephone survey was conducted for 1983. FTE R&D scientists and engineers data for the academic and nonprofit sectors have since been based on trends in the national R&D expenditures/R&D employment ratio.

list of supporting r&d data sources

National Science Foundation, *Federal Funds for Research and Development: Fiscal Years 1988, 1989, and 1990*,NSF 90-306 (Washington, D.C., 1990). Detailed statistical tables cover R&D (and R&D plant) funding levels through August 1989 as reported by all Federal agencies with R&D programs. Includes data by agency, performer, character of work, geographic distribution, and field of science/engineering.

National Science Foundation, *Federal R&D Funding by Budget Function: Fiscal Years 1989-91*, NSF 90-311 (Washington, D.C., 1990). Provides information on Federal R&D budget authority by Federal budget function as proposed in the Administration's 1991 budget.

Office of Management and Budget, "Special Analysis J,"*The Budget of the United States Government, Fiscal Year 1990* (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, 1989). Provides quantitative and qualitative information on R&D funding as proposed in the Administration's 1990 budget.

Office of Management and Budget, *The Budget of the United States Government, Fiscal Year 1991* (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, 1990). Provides quantitative and qualitative information on R&D funding as proposed in the Administration's 1991 budget.

National Science Foundation, *Research and Development in Industry: 1987*, NSF 89-323 (Washington, D.C. 1989) and *Research and Development in Industry: 1988* (forthcoming). Detailed statistical tables cover industrial R&D performance as reported in a sample survey of companies. Data include distribution by source of funds, industry classification, character of work, product field, geographic location, company size, and other tabulations.

National Science Foundation, "Slow R&D Spending Growth Continues into 1990s," Science Resources Studies Highlights (NSF 90-307, March 9, 1990). Brief summary of expected 1989 and 1990 company financing of R&D, based on a mail/telephone survey of major industrial R&D performers as of September 1989.

National Science Foundation, *Academic Science/Engineering: R&D Funds: Fiscal Year 1988*, NSF 89-326 (Washington, D.C., 1989). Detailed statistical tables cover academic R&D performance as reported in a survey of U.S. universities and university-administered FFRDCs. Data include distribution by source of funds, performing institution, character of work, field of science, and geographic location.

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Table B-1. National research and development expenditures by performing sector and source of funds 1/: 1953-90

(Dollars in millions)

	UNITED STATES	FEDERAL GOVT.	INDUSTRY 3/			UNIVERSITIES & COLLEGES					U&C FFRDCs	OTHER NONPROFIT INSTITUTIONS 3/			
				Sources			Sources						Sources		
YEAR	Total funds	Total used 2/	Total used	Federal Govt.	Industry 5/	Total used	Federal Govt.	Indus-try	Univ.& Coll.5/	Non-Prof.	Total used 4/	Total used	Federal Govt.	Indus-try	Non-Profits 5/
1953	5,124	1,010	3,630	1,430	2,200	255	138	19	72	26	121	108	54	26	28
1954	5,644	1,020	4,070	1,750	2,320	290	160	22	80	28	141	123	61	31	31
1955	6,172	905	4,640	2,180	2,460	312	169	25	88	30	180	135	68	35	32
1956	8,364	1,041	6,605	3,328	3,277	372	213	29	96	34	194	152	77	37	38
1957	9,775	1,220	7,731	4,335	3,396	410	229	34	109	38	240	174	86	37	51
1958	10,711	1,374	8,389	4,759	3,630	456	254	39	121	42	293	199	99	38	62
1959	12,357	1,639	9,618	5,635	3,983	526	306	39	134	47	338	236	127	42	67
1960	13,520	1,723	10,509	6,081	4,428	646	405	40	149	52	360	282	166	48	68
1961	14,320	1,878	10,908	6,240	4,668	763	500	40	165	58	410	361	226	49	86
1962	15,392	2,096	11,464	6,435	5,029	904	613	40	185	66	470	458	295	54	109
1963	17,059	2,279	12,630	7,270	5,360	1,081	760	41	207	73	530	539	365	55	119
1964	18,854	2,838	13,512	7,720	5,792	1,275	917	40	235	83	629	600	433	55	112
1965	20,044	3,093	14,185	7,740	6,445	1,474	1,073	41	267	93	629	663	477	62	124
1966	21,846	3,220	15,548	8,332	7,216	1,715	1,261	42	304	108	630	733	525	70	138
1967	23,146	3,396	16,385	8,365	8,020	1,921	1,409	48	345	119	673	771	552	74	145
1968	24,605	3,494	17,429	8,560	8,869	2,149	1,572	55	390	132	719	814	582	81	151
1969	25,629	3,501	18,308	8,451	9,857	2,225	1,600	60	420	145	725	870	616	93	161
1970	26,134	4,079	18,067	7,779	10,288	2,335	1,647	61	462	165	737	916	649	95	172
1971	26,676	4,228	18,320	7,666	10,654	2,500	1,724	70	529	177	716	912	630	98	184
1972	28,476	4,589	19,552	8,017	11,535	2,630	1,795	74	574	187	753	952	653	101	198
1973	30,718	4,762	21,249	8,145	13,104	2,884	1,985	84	613	202	817	1,006	690	105	211
1974	32,863	4,911	22,887	8,220	14,667	3,022	2,032	95	676	219	865	1,178	822	115	241
1975	35,213	5,354	24,187	8,605	15,582	3,409	2,288	113	749	259	987	1,276	875	125	276
1976	39,018	5,769	26,997	9,561	17,436	3,729	2,512	123	809	285	1,147	1,376	925	135	316
1977	42,783	6,012	29,825	10,485	19,340	4,067	2,726	139	888	314	1,384	1,495	987	150	358
1978	48,128	6,810	33,304	11,189	22,115	4,625	3,059	170	1,037	359	1,717	1,672	1,100	165	407
1979	54,926	7,418	38,226	12,518	25,708	5,353	3,595	195	1,198	365	1,935	1,994	1,350	180	464
1980	62,582	7,632	44,505	14,029	30,476	6,049	4,095	238	1,316	400	2,246	2,150	1,450	200	500
1981	71,851	8,426	51,810	16,382	35,428	6,829	4,561	294	1,540	434	2,486	2,300	1,550	225	525
1982	80,001	9,141	58,650	18,545	40,105	7,306	4,759	339	1,719	489	2,479	2,425	1,650	250	525
1983	89,126	10,582	65,268	20,680	44,588	7,864	4,980	389	1,918	577	2,737	2,675	1,850	275	550
1984	101,116	11,572	74,800	23,396	51,404	8,594	5,417	474	2,091	612	3,150	3,000	2,100	325	575
1985	113,745	12,945	84,239	27,196	57,043	9,663	6,056	561	2,356	690	3,523	3,375	2,350	375	650
1986	119,863	13,535	88,179	28,247	59,932	10,904	6,702	717	2,772	713	3,895	3,350	2,250	425	675
1987	127,316	13,413	94,117	31,311	62,806	12,080	7,328	807	3,135	810	4,206	3,500	2,250	475	775
1988	135,231	14,281	99,422	32,959	66,463	13,422	8,165	892	3,437	928	4,531	3,575	2,200	500	875
1989	142,000	15,800	103,000	34,200	68,800	14,450	8,600	1,000	3,850	1,000	4,850	3,900	2,400	550	950
1990	150,000	16,700	108,150	35,650	72,500	15,800	9,200	1,150	4,300	1,150	5,250	4,100	2,400	600	1,100

1/ Data based on annual reports by performers except for the nonprofit sector which, since 1973, have been estimated based on a survey conducted in that year. Data are preliminary for 1989 and estimated for 1990.

2/ Total funds used by Federal Government from Federal sources.

3/ Expenditures for federally funded research and development centers (FFRDCs) administered by industry and nonprofit institutions are included in the totals of the respective sectors.

4/ FFRDCs administered by individual universities and and colleges and by university consortia. In 1988, 99 percent of total funds used was from Federal sources.

5/ Includes State and local government funds.

NOTE: For 1986, industry performance with Federal as a source of funds is $356 million larger than the amounts reported above. As as result, total U.S. R&D expenditures for 1986 are equal to $120,219 million. (See General Notes in this report.)

SOURCE: National Science Foundation, SRS. Incorporates data available to SRS as of April 26, 1990.

Table B-2. National basic research expenditures by performing sector and source of funds 1/: 1953-90

(Dollars in millions)

	UNITED STATES	FEDERAL GOVT.	INDUSTRY 3/			UNIVERSITIES & COLLEGES					U&C FFRDCs	OTHER NONPROFIT INSTITUTIONS 3/			
				Sources 7/			Sources 5/						Sources		
YEAR	Total funds	Total used 2/	Total used	Federal Govt.	Industry 6/	Total used	Federal Govt.	Indus-try	Univ.& Coll.6/	Non-Prof.	Total used 4/	Total used	Federal Govt.	Indus-try	Non-Profits 6/
1953	441	101	151	19	132	110	73	12	10	15	33	46	25	9	12
1954	496	102	166	23	143	136	90	14	15	17	39	53	29	11	13
1955	547	90	189	27	162	159	103	16	21	19	49	60	33	13	14
1956	680	105	253	37	216	200	130	18	30	22	51	71	39	15	17
1957	780	122	271	41	230	240	155	21	39	25	65	82	44	15	23
1958	877	126	295	43	252	281	178	24	50	29	78	97	53	16	28
1959	1,039	172	320	72	248	343	226	24	60	33	92	112	64	18	30
1960	1,194	157	376	79	297	433	299	24	72	38	97	131	80	21	30
1961	1,405	210	395	81	314	536	382	25	85	44	115	149	90	22	37
1962	1,722	249	488	143	345	659	481	25	102	51	136	190	120	24	46
1963	1,965	255	522	147	375	814	610	25	121	58	159	215	140	25	50
1964	2,289	314	549	165	384	1,003	768	24	144	67	191	232	160	25	47
1965	2,555	364	592	186	406	1,138	879	26	164	69	208	253	172	29	52
1966	2,814	385	624	173	451	1,303	1,008	27	197	71	227	275	185	32	58
1967	3,056	435	629	202	427	1,457	1,124	31	223	79	250	285	190	34	61
1968	3,297	432	642	180	462	1,650	1,251	36	276	87	276	297	197	37	63
1969	3,441	532	618	160	458	1,711	1,279	39	298	95	275	305	195	43	67
1970	3,531	559	602	158	444	1,796	1,296	40	350	110	269	305	189	44	72
1971	3,652	566	590	134	456	1,914	1,349	46	400	119	260	322	200	45	77
1972	3,801	597	593	130	463	2,022	1,420	53	415	134	244	345	214	47	84
1973	3,945	608	631	132	499	2,053	1,454	57	408	134	296	357	218	49	90
1974	4,343	696	699	163	536	2,153	1,523	60	431	139	390	405	245	54	106
1975	4,738	734	730	157	573	2,410	1,694	72	478	166	439	425	245	60	120
1976	5,130	786	819	185	634	2,549	1,841	71	475	162	512	464	265	64	135
1977	5,735	914	911	210	701	2,800	2,007	79	527	187	600	510	290	70	150
1978	6,692	1,029	1,035	250	785	3,176	2,264	99	605	208	867	585	335	80	170
1979	7,548	1,089	1,158	265	893	3,606	2,568	115	707	216	1,015	680	400	85	195
1980	8,410	1,182	1,325	290	1,035	4,019	2,852	142	786	239	1,124	760	450	95	215
1981	9,580	1,302	1,614	301	1,313	4,578	3,249	172	903	254	1,261	825	495	105	225
1982	10,415	1,465	1,904	381	1,523	4,864	3,392	196	993	283	1,317	865	535	115	215
1983	11,618	1,690	2,223	463	1,760	5,288	3,538	236	1,164	350	1,472	945	600	125	220
1984	12,883	1,861	2,608	476	2,132	5,709	3,816	282	1,246	365	1,675	1,030	650	150	230
1985	14,178	1,923	2,862	489	2,373	6,539	4,341	342	1,436	420	1,749	1,105	675	170	260
1986	16,570	2,019	4,046	550	3,496	7,476	4,866	445	1,722	443	1,859	1,170	700	200	270
1987	17,780	2,046	4,149	757	3,392	8,343	5,372	505	1,960	506	2,012	1,230	700	220	310
1988	18,460	2,050	3,988	633	3,355	8,870	5,661	544	2,099	566	2,222	1,330	750	230	350
1989	19,880	2,350	4,050	650	3,400	9,600	6,000	615	2,370	615	2,450	1,430	800	250	380
1990	21,490	2,400	4,200	700	3,500	10,570	6,550	700	2,620	700	2,750	1,570	850	280	440

1/ Data based on annual reports by performers except for the nonprofit sector which, since 1973, have been estimated based on a survey conducted in that year. Data for all sectors are preliminary for 1989 and estimated for 1990.

2/ Total funds used by Federal Government from Federal sources.

3/ Expenditures for federally funded research and development centers (FFRDCs) administered by industry and nonprofit institutions are included in the totals of the respective sectors.

4/ FFRDCs administered by individual universities and and colleges and by university consortia.

5/ Distribution by non-Federal sources has been estimated for all years.

6/ Includes State and local government funds.

7/ Imputation procedure changed for 1986 and later years. These data may not be comparable to data for 1985 and earlier.

SOURCE: National Science Foundation, SRS. Incorporates data available to SRS as of April 26, 1990.

Table B-3. National applied research expenditures by performing sector and source of funds 1/: 1953-90

(Dollars in millions)

	UNITED STATES	FEDERAL GOVT.	INDUSTRY 3/ Sources 7/			UNIVERSITIES & COLLEGES Sources 5/					U&C FFRDCs	OTHER NONPROFIT INSTITUTIONS 3/ Sources			
YEAR	Total funds	Total used 2/	Total used	Federal Govt.	Industry 6/	Total used	Federal Govt.	Indus-try	Univ.& Coll.6/	Non-Prof.	Total used 4/	Total used	Federal Govt.	Indus-try	Non-Profits 6/
1953	1,279	345	726	288	438	130	57	6	57	10	44	34	13	11	10
1954	1,390	349	814	322	492	137	61	7	59	10	51	39	15	13	11
1955	1,481	310	928	368	560	136	58	8	60	10	65	42	17	14	11
1956	1,889	356	1,268	474	794	147	68	9	59	11	71	47	19	14	14
1957	2,374	417	1,670	678	992	145	62	11	61	11	86	56	22	14	20
1958	2,699	474	1,911	774	1,137	148	64	12	61	11	102	64	25	14	25
1959	2,900	558	1,991	813	1,178	155	67	12	64	12	119	77	35	15	27
1960	3,020	595	2,029	833	1,196	179	88	13	66	12	122	95	50	17	28
1961	3,065	634	1,977	812	1,165	192	98	13	69	12	135	127	75	17	35
1962	3,665	702	2,449	1,011	1,438	205	109	13	70	13	155	154	90	19	45
1963	3,742	715	2,457	1,007	1,450	227	128	14	72	13	170	173	105	19	49
1964	4,128	903	2,600	1,040	1,560	232	127	14	77	14	202	191	125	19	47
1965	4,339	990	2,658	1,038	1,620	279	157	13	88	21	204	208	135	21	52
1966	4,601	997	2,843	1,039	1,804	328	194	13	89	32	207	226	145	24	57
1967	4,780	1,027	2,915	1,066	1,849	374	222	15	102	35	219	245	160	25	60
1968	5,130	1,110	3,124	1,043	2,081	403	253	16	97	37	231	262	172	28	62
1969	5,315	1,113	3,287	1,015	2,272	407	246	16	105	40	210	298	200	32	66
1970	5,738	1,345	3,427	1,049	2,378	427	267	16	99	45	216	323	220	33	70
1971	5,759	1,322	3,415	974	2,441	474	292	19	115	48	210	338	230	34	74
1972	6,011	1,387	3,514	952	2,562	524	320	18	140	46	221	365	251	35	79
1973	6,598	1,480	3,825	993	2,832	713	461	23	172	57	227	353	234	36	83
1974	7,189	1,574	4,288	1,025	3,263	736	438	29	203	66	178	413	280	40	93
1975	7,812	1,730	4,570	1,130	3,440	851	516	34	224	77	213	448	300	43	105
1976	8,983	2,093	5,112	1,200	3,912	1,016	584	43	282	107	264	498	330	48	120
1977	9,651	2,044	5,636	1,325	4,311	1,067	607	46	303	111	371	533	345	53	135
1978	10,725	2,191	6,300	1,430	4,870	1,213	673	56	354	130	431	590	385	55	150
1979	12,268	2,392	7,225	1,555	5,670	1,473	877	66	407	123	468	710	480	60	170
1980	13,855	2,484	8,450	1,900	6,550	1,693	1,043	79	438	133	503	725	480	65	180
1981	16,607	2,732	10,699	2,340	8,359	1,867	1,087	101	529	150	529	780	515	75	190
1982	18,512	2,729	12,323	2,960	9,363	2,039	1,142	119	606	172	606	815	540	85	190
1983	20,698	3,020	13,927	3,641	10,286	2,150	1,217	126	620	187	726	875	580	95	200
1984	22,850	2,903	15,765	4,224	11,541	2,463	1,401	159	699	204	804	915	600	110	205
1985	25,830	3,133	18,255	5,347	12,908	2,672	1,515	180	755	222	835	935	575	130	230
1986	27,550	3,141	19,741	4,659	15,082	2,909	1,611	222	856	220	774	985	600	140	245
1987	28,976	3,392	20,671	4,937	15,734	3,155	1,706	246	956	247	693	1,065	625	160	280
1988	30,897	3,288	21,868	5,269	16,599	3,909	2,229	286	1,097	297	697	1,135	650	170	315
1989	32,290	3,550	22,700	5,500	17,200	4,140	2,300	315	1,210	315	720	1,180	650	190	340
1990	33,785	3,550	23,800	5,700	18,100	4,445	2,325	370	1,380	370	740	1,250	650	200	400

1/ Data based on annual reports by performers except for the nonprofit sector which, since 1973, have been estimated based on a survey conducted in that year. Data for all secors are preliminary for 1989 and estimated for 1990.

2/ Total funds used by Federal Government from Federal sources.

3/ Expenditures for federally funded research and development centers (FFRDCs) administered by industry and nonprofit institutions are included in the totals of the respective sectors.

4/ FFRDCs administered by individual universities and and colleges and by university consortia. Data have been estimated since 1978.

5/ Applied research totals have been estimated since 1978. Distribution by non-Federal sources has been estimated for all years.

6/ Includes State and local government funds.

7/ Imputation procedure changed for 1986 and later years. These data may not be comparable to data for 1985 and earlier.

SOURCE: National Science Foundation, SRS. Incorporates data available to SRS as of April 26, 1990.

Table B-4. National development expenditures by performing sector and source of funds 1/: 1953-90

(Dollars in millions)

	UNITED STATES	FEDERAL GOVT.	INDUSTRY 3/			UNIVERSITIES & COLLEGES					U&C FFRDCs	OTHER NONPROFIT INSTITUTIONS 3/			
				Sources 7/			Sources 5/						Sources		
YEAR	Total funds	Total used 2/	Total used	Federal Govt.	Industry 6/	Total used	Federal Govt.	Industry	Univ.& Coll.6/	Non-Prof.	Total used 4/	Total used	Federal Govt.	Industry	Non-Profits 6/
1953	3,404	564	2,753	1,123	1,630	15	8	1	5	1	44	28	16	6	6
1954	3,758	569	3,090	1,405	1,685	17	9	1	6	1	51	31	17	7	7
1955	4,144	505	3,523	1,785	1,738	17	8	1	7	1	66	33	18	8	7
1956	5,795	580	5,084	2,817	2,267	25	15	2	7	1	72	34	19	8	7
1957	6,621	681	5,790	3,616	2,174	25	12	2	9	2	89	36	20	8	8
1958	7,135	774	6,183	3,942	2,241	27	12	3	10	2	113	38	21	8	9
1959	8,418	909	7,307	4,750	2,557	28	13	3	10	2	127	47	28	9	10
1960	9,306	971	8,104	5,169	2,935	34	18	3	11	2	141	56	36	10	10
1961	9,850	1,034	8,536	5,347	3,189	35	20	2	11	2	160	85	61	10	14
1962	10,005	1,145	8,527	5,281	3,246	40	23	2	13	2	179	114	85	11	18
1963	11,352	1,309	9,651	6,116	3,535	40	22	2	14	2	201	151	120	11	20
1964	12,437	1,621	10,363	6,515	3,848	40	22	2	14	2	236	177	148	11	18
1965	13,150	1,739	10,935	6,516	4,419	57	37	2	15	3	217	202	170	12	20
1966	14,431	1,838	12,081	7,120	4,961	84	59	2	18	5	196	232	195	14	23
1967	15,310	1,934	12,841	7,097	5,744	90	63	2	20	5	204	241	202	15	24
1968	16,178	1,952	13,663	7,337	6,326	96	68	3	17	8	212	255	213	16	26
1969	16,873	1,856	14,403	7,276	7,127	107	75	5	17	10	240	267	221	18	28
1970	16,865	2,175	14,038	6,572	7,466	112	84	5	13	10	252	288	240	18	30
1971	17,265	2,340	14,315	6,558	7,757	112	83	5	14	10	246	252	200	19	33
1972	18,664	2,605	15,445	6,935	8,510	84	55	3	19	7	288	242	188	19	35
1973	20,175	2,674	16,793	7,020	9,773	118	70	4	33	11	294	296	238	20	38
1974	21,331	2,641	17,900	7,032	10,868	133	71	6	42	14	297	360	297	21	42
1975	22,663	2,890	18,887	7,318	11,569	148	78	7	47	16	335	403	330	22	51
1976	24,905	2,890	21,066	8,176	12,890	164	87	9	52	16	371	414	330	23	61
1977	27,397	3,054	23,278	8,950	14,328	200	112	14	58	16	413	452	352	27	73
1978	30,711	3,590	25,969	9,509	16,460	236	122	15	78	21	419	497	380	30	87
1979	35,110	3,937	29,843	10,698	19,145	274	150	14	84	26	452	604	470	35	99
1980	40,317	3,966	34,730	11,839	22,891	337	200	17	92	28	619	665	520	40	105
1981	45,664	4,392	39,497	13,741	25,756	384	225	21	108	30	696	695	540	45	110
1982	51,074	4,947	44,423	15,204	29,219	403	225	24	120	34	556	745	575	50	120
1983	56,810	5,872	49,118	16,576	32,542	426	225	27	134	40	539	855	670	55	130
1984	65,383	6,808	56,427	18,696	37,731	422	200	33	146	43	671	1,055	850	65	140
1985	73,737	7,889	63,122	21,360	41,762	452	200	39	165	48	939	1,335	1,100	75	160
1986	75,743	8,375	64,392	23,038	41,354	519	225	50	194	50	1,262	1,195	950	85	160
1987	80,560	7,975	69,297	25,617	43,680	582	250	56	219	57	1,501	1,205	925	95	185
1988	85,874	8,943	73,566	27,057	46,509	643	275	62	241	65	1,612	1,110	800	100	210
1989	89,830	9,900	76,250	28,050	48,200	710	300	70	270	70	1,680	1,290	950	110	230
1990	94,725	10,750	80,150	29,250	50,900	785	325	80	300	80	1,760	1,280	900	120	260

1/ Data based on annual reports by performers except for the nonprofit sector which, since 1973, have been estimated based on a survey conducted in that year. Data for all sectors are preliminary for 1989 and estimated for 1990.

2/ Total funds used by Federal Government from Federal sources.

3/ Expenditures for federally funded research and development centers (FFRDCs) administered by industry and nonprofit institutions are included in the totals of the respective sectors.

4/ FFRDCs administered by individual universities and and colleges and by university consortia. Data have been estimated since 1978.

5/ Development totals have been estimated since 1978. Distribution by non-Federal sources has been estimated for all years.

6/ Includes State and local government funds.

7/ Imputation procedure changed for 1986 and later years. These data may not be comparable to data for 1985 and earlier.

SOURCE: National Science Foundation, SRS. Incorporates data available to SRS as of April 26, 1990.

Table B-5. Sources of funds for research and development by sector: 1953-90

(Dollars in millions)

	Current Dollars					Real (1982) Dollars 1/				
YEAR	UNITED STATES	FEDERAL GOVT.	INDUSTRY	UNIV. & COLLEGES	OTHER NONPROFIT	UNITED STATES	FEDERAL GOVT.	INDUSTRY	UNIV. & COLLEGES	OTHER NONPROFIT
1953	5,124	2,753	2,245	72	54	19,743	10,590	8,671	276	208
1954	5,644	3,132	2,373	80	59	21,446	11,896	9,023	303	224
1955	6,172	3,502	2,520	88	62	22,759	12,922	9,282	326	229
1956	8,364	4,853	3,343	96	72	29,826	17,315	11,910	344	257
1957	9,775	6,110	3,467	109	89	33,641	21,035	11,923	376	307
1958	10,711	6,779	3,707	121	104	36,077	22,826	12,494	406	350
1959	12,357	8,045	4,064	134	114	40,595	26,430	13,351	440	375
1960	13,520	8,735	4,516	149	120	43,639	28,183	14,591	479	387
1961	14,320	9,254	4,757	165	144	45,777	29,566	15,226	525	460
1962	15,392	9,909	5,123	185	175	48,171	31,006	16,039	578	548
1963	17,059	11,204	5,456	207	192	52,583	34,518	16,839	635	591
1964	18,854	12,537	5,887	235	195	57,203	38,023	17,877	711	591
1965	20,044	13,012	6,548	267	217	59,351	38,533	19,384	791	643
1966	21,846	13,968	7,328	304	246	62,589	40,046	20,962	875	706
1967	23,146	14,395	8,142	345	264	64,409	40,059	22,654	960	735
1968	24,605	14,927	9,005	390	283	65,458	39,785	23,869	1,049	755
1969	25,629	14,893	10,010	420	306	64,668	37,657	25,166	1,072	775
1970	26,134	14,891	10,444	462	337	62,403	35,632	24,851	1,114	807
1971	26,676	14,964	10,822	529	361	60,384	33,965	24,387	1,212	820
1972	28,476	15,807	11,710	574	385	61,412	34,144	25,190	1,246	832
1973	30,718	16,399	13,293	613	413	62,427	33,478	26,837	1,268	844
1974	32,863	16,850	14,877	676	460	61,466	31,727	27,577	1,296	867
1975	35,213	18,109	15,820	749	535	59,882	30,985	26,679	1,302	916
1976	39,018	19,914	17,694	809	601	62,134	31,813	28,058	1,303	960
1977	42,783	21,594	19,629	888	672	63,653	32,152	29,176	1,325	1,001
1978	48,128	23,875	22,450	1,037	766	66,768	33,171	31,087	1,446	1,064
1979	54,926	26,816	26,083	1,198	829	70,069	34,273	33,199	1,538	1,059
1980	62,582	29,452	30,914	1,316	900	73,222	34,547	36,067	1,553	1,055
1981	71,851	33,405	35,947	1,540	959	76,623	35,686	38,260	1,652	1,024
1982	80,001	36,574	40,694	1,719	1,014	80,001	36,574	40,694	1,719	1,014
1983	89,126	40,829	45,252	1,918	1,127	85,741	39,249	43,569	1,840	1,083
1984	101,116	45,635	52,203	2,091	1,187	93,768	42,281	48,455	1,933	1,099
1985	113,745	52,070	57,979	2,356	1,340	102,396	46,825	52,254	2,112	1,205
1986	119,863	54,629	61,074	2,772	1,388	105,159	47,868	53,655	2,421	1,216
1987	127,316	58,508	64,088	3,135	1,585	108,317	49,728	54,586	2,657	1,347
1988	135,231	62,136	67,855	3,437	1,803	111,434	51,175	55,947	2,827	1,485
1989	142,000	65,850	70,350	3,850	1,950	112,080	51,957	55,550	3,035	1,538
1990	150,000	69,200	74,250	4,300	2,250	113,593	52,379	56,261	3,250	1,703

1/ Based on GNP implicit price deflator.

SOURCE: National Science Foundation, SRS. Incorporates data available to SRS as of April 26, 1990.

Table B-6. Research and development performance by sector: 1953-90

(Dollars in millions)

	Current Dollars						Real (1982) Dollars 1/					
YEAR	UNITED STATES	FEDERAL GOVT.	INDUSTRY	UNIV. & COLLEGES	U&C FFRDCs	OTHER NONPROFIT	UNITED STATES	FEDERAL GOVT.	INDUSTRY	UNIV. & COLLEGES	U&C FFRDCs	OTHER NONPROFIT
1953	5,124	1,010	3,630	255	121	108	19,743	3,866	14,021	976	463	417
1954	5,644	1,020	4,070	290	141	123	21,446	3,868	15,475	1,100	535	468
1955	6,172	905	4,640	312	180	135	22,759	3,350	17,090	1,155	666	497
1956	8,364	1,041	6,605	372	194	152	29,826	3,728	23,530	1,332	695	542
1957	9,775	1,220	7,731	410	240	174	33,641	4,213	26,585	1,416	829	598
1958	10,711	1,374	8,389	456	293	199	36,077	4,616	28,274	1,532	984	671
1959	12,357	1,639	9,618	526	338	236	40,595	5,385	31,597	1,728	1,110	775
1960	13,520	1,723	10,509	646	360	282	43,639	5,539	33,955	2,077	1,157	911
1961	14,320	1,878	10,908	763	410	361	45,777	5,973	34,917	2,427	1,304	1,156
1962	15,392	2,096	11,464	904	470	458	48,171	6,551	35,892	2,825	1,469	1,434
1963	17,059	2,279	12,630	1,081	530	539	52,583	6,994	38,981	3,318	1,627	1,664
1964	18,854	2,838	13,512	1,275	629	600	57,203	8,587	41,032	3,858	1,903	1,822
1965	20,044	3,093	14,185	1,474	629	663	59,351	9,165	41,992	4,368	1,864	1,963
1966	21,846	3,220	15,548	1,715	630	733	62,589	9,269	44,474	4,937	1,813	2,097
1967	23,146	3,396	16,385	1,921	673	771	64,409	9,453	45,590	5,347	1,873	2,145
1968	24,605	3,494	17,429	2,149	719	814	65,458	9,395	46,194	5,778	1,933	2,157
1969	25,629	3,501	18,308	2,225	725	870	64,668	8,932	46,023	5,677	1,850	2,187
1970	26,134	4,079	18,067	2,335	737	916	62,403	9,833	42,986	5,629	1,777	2,179
1971	26,676	4,228	18,320	2,500	716	912	60,384	9,684	41,280	5,726	1,640	2,055
1972	28,476	4,589	19,552	2,630	753	952	61,412	9,963	42,056	5,710	1,635	2,048
1973	30,718	4,762	21,249	2,884	817	1,006	62,427	9,849	42,893	5,965	1,690	2,031
1974	32,863	4,911	22,887	3,022	865	1,178	61,466	9,416	42,415	5,794	1,658	2,183
1975	35,213	5,354	24,187	3,409	987	1,276	59,882	9,308	40,781	5,926	1,716	2,151
1976	39,018	5,769	26,997	3,729	1,147	1,376	62,134	9,293	42,805	6,007	1,848	2,182
1977	42,783	6,012	29,825	4,067	1,384	1,495	63,653	8,969	44,330	6,067	2,065	2,222
1978	48,128	6,810	33,304	4,625	1,717	1,672	66,768	9,495	46,115	6,449	2,394	2,315
1979	54,926	7,418	38,226	5,353	1,935	1,994	70,069	9,523	48,652	6,872	2,484	2,538
1980	62,582	7,632	44,505	6,049	2,246	2,150	73,222	9,006	51,919	7,138	2,650	2,508
1981	71,851	8,426	51,810	6,829	2,486	2,300	76,623	9,040	55,140	7,327	2,667	2,448
1982	80,001	9,141	58,650	7,306	2,479	2,425	80,001	9,141	58,650	7,306	2,479	2,425
1983	89,126	10,582	65,268	7,864	2,737	2,675	85,741	10,152	62,842	7,545	2,626	2,576
1984	101,116	11,572	74,800	8,594	3,150	3,000	93,768	10,696	69,433	7,943	2,912	2,785
1985	113,745	12,945	84,239	9,663	3,523	3,375	102,396	11,606	75,925	8,664	3,159	3,042
1986	119,863	13,535	88,179	10,904	3,895	3,350	105,159	11,820	77,472	9,522	3,401	2,943
1987	127,316	13,413	94,117	12,080	4,206	3,500	108,317	11,367	80,168	10,237	3,564	2,981
1988	135,231	14,281	99,422	13,422	4,531	3,575	111,434	11,744	81,977	11,038	3,726	2,948
1989	142,000	15,800	103,000	14,450	4,850	3,900	112,080	12,454	81,333	11,390	3,823	3,080
1990	150,000	16,700	108,150	15,800	5,250	4,100	113,593	12,624	81,950	11,943	3,969	3,107

1/ Based on GNP implicit price deflator.

SOURCE: National Science Foundation, SRS. Incorporates data available to SRS as of April 26, 1990.

Table B-7. Sources of funds for basic research by sector: 1953-90

(Dollars in millions)

	Current Dollars					Real (1982) Dollars 1/				
YEAR	UNITED STATES	FEDERAL GOVT.	INDUSTRY	UNIV. & COLLEGES	OTHER NONPROFIT	UNITED STATES	FEDERAL GOVT.	INDUSTRY	UNIV. & COLLEGES	OTHER NONPROFIT
1953	441	251	153	10	27	1,695	962	591	38	104
1954	496	283	168	15	30	1,883	1,074	639	57	114
1955	547	302	191	21	33	2,020	1,117	704	78	122
1956	680	362	249	30	39	2,429	1,295	887	107	139
1957	780	427	266	39	48	2,688	1,473	915	135	165
1958	877	478	292	50	57	2,950	1,607	984	168	192
1959	1,039	626	290	60	63	3,413	2,057	953	197	207
1960	1,194	712	342	72	68	3,847	2,292	1,105	231	219
1961	1,405	878	361	85	81	4,480	2,796	1,155	270	258
1962	1,722	1,129	394	102	97	5,386	3,530	1,233	319	303
1963	1,965	1,311	425	121	108	6,043	4,028	1,311	371	332
1964	2,289	1,598	433	144	114	6,935	4,839	1,315	436	345
1965	2,555	1,809	461	164	121	7,568	5,359	1,365	486	358
1966	2,814	1,978	510	197	129	8,084	5,687	1,459	567	370
1967	3,056	2,201	492	223	140	8,505	6,126	1,369	621	390
1968	3,297	2,336	535	276	150	8,829	6,267	1,419	742	401
1969	3,441	2,441	540	298	162	8,744	6,214	1,359	760	411
1970	3,531	2,471	528	350	182	8,483	5,946	1,257	844	436
1971	3,652	2,509	547	400	196	8,331	5,734	1,234	916	446
1972	3,801	2,605	563	415	218	8,233	5,649	1,212	901	472
1973	3,945	2,708	605	408	224	8,110	5,583	1,224	844	459
1974	4,343	3,017	650	431	245	8,256	5,758	1,208	826	463
1975	4,738	3,269	705	478	286	8,176	5,662	1,192	831	491
1976	5,130	3,589	769	475	297	8,231	5,770	1,221	765	475
1977	5,735	4,021	850	527	337	8,548	5,996	1,264	786	502
1978	6,692	4,745	964	605	378	9,315	6,610	1,336	844	525
1979	7,548	5,337	1,093	707	411	9,670	6,844	1,392	908	525
1980	8,410	5,898	1,272	786	454	9,896	6,950	1,486	928	533
1981	9,580	6,608	1,590	903	479	10,257	7,083	1,694	969	512
1982	10,415	7,090	1,834	993	498	10,415	7,090	1,834	993	498
1983	11,618	7,763	2,121	1,164	570	11,157	7,451	2,041	1,117	548
1984	12,883	8,478	2,564	1,246	595	11,922	7,841	2,379	1,152	551
1985	14,178	9,177	2,885	1,436	680	12,731	8,234	2,599	1,288	611
1986	16,570	9,994	4,141	1,722	713	14,498	8,734	3,636	1,504	624
1987	17,780	10,887	4,117	1,960	816	15,091	9,232	3,505	1,661	693
1988	18,460	11,316	4,129	2,099	916	15,193	9,309	3,403	1,726	754
1989	19,880	12,250	4,265	2,370	995	15,678	9,658	3,367	1,868	785
1990	21,490	13,250	4,480	2,620	1,140	16,255	10,019	3,393	1,980	863

1/ Based on GNP implicit price deflator.

SOURCE: National Science Foundation, SRS. Incorporates data available to SRS as of April 26, 1990.

Table B-8. Basic research performance by sector: 1953-90

(Dollars in millions)

YEAR	Current Dollars						Real (1982) Dollars 1/					
	UNITED STATES	FEDERAL GOVT.	INDUSTRY	UNIV. & COLLEGES	U&C FFRDCs	OTHER NONPROFIT	UNITED STATES	FEDERAL GOVT.	INDUSTRY	UNIV. & COLLEGES	U&C FFRDCs	OTHER NONPROFIT
1953	441	101	151	110	33	46	1,695	387	583	421	126	178
1954	496	102	166	136	39	53	1,883	387	631	516	148	202
1955	547	90	189	159	49	60	2,020	333	696	589	181	221
1956	680	105	253	200	51	71	2,429	376	901	716	183	253
1957	780	122	271	240	65	82	2,688	421	932	829	224	282
1958	877	126	295	281	78	97	2,950	423	994	944	262	327
1959	1,039	172	320	343	92	112	3,413	565	1,051	1,127	302	368
1960	1,194	157	376	433	97	131	3,847	505	1,215	1,392	312	423
1961	1,405	210	395	536	115	149	4,480	668	1,264	1,705	366	477
1962	1,722	249	488	659	136	190	5,386	778	1,528	2,060	425	595
1963	1,965	255	522	814	159	215	6,043	783	1,611	2,498	488	664
1964	2,289	314	549	1,003	191	232	6,935	950	1,667	3,035	578	705
1965	2,555	364	592	1,138	208	253	7,568	1,079	1,753	3,372	616	749
1966	2,814	385	624	1,303	227	275	8,084	1,108	1,785	3,751	653	787
1967	3,056	435	629	1,457	250	285	8,505	1,211	1,750	4,056	696	793
1968	3,297	432	642	1,650	276	297	8,829	1,162	1,702	4,437	742	787
1969	3,441	532	618	1,711	275	305	8,744	1,357	1,554	4,365	702	767
1970	3,531	559	602	1,796	269	305	8,483	1,347	1,432	4,329	648	726
1971	3,652	566	590	1,914	260	322	8,331	1,296	1,329	4,384	595	726
1972	3,801	597	593	2,022	244	345	8,233	1,296	1,276	4,390	530	742
1973	3,945	608	631	2,053	296	357	8,110	1,258	1,274	4,246	612	721
1974	4,343	696	699	2,153	390	405	8,256	1,334	1,295	4,128	748	751
1975	4,738	734	730	2,410	439	425	8,176	1,276	1,231	4,190	763	717
1976	5,130	786	819	2,549	512	464	8,231	1,266	1,299	4,106	825	736
1977	5,735	914	911	2,800	600	510	8,548	1,364	1,354	4,177	895	758
1978	6,692	1,029	1,035	3,176	867	585	9,315	1,435	1,433	4,428	1,209	810
1979	7,548	1,089	1,158	3,606	1,015	680	9,670	1,398	1,474	4,629	1,303	865
1980	8,410	1,182	1,325	4,019	1,124	760	9,896	1,395	1,546	4,743	1,326	887
1981	9,580	1,302	1,614	4,578	1,261	825	10,257	1,397	1,718	4,912	1,353	878
1982	10,415	1,465	1,904	4,864	1,317	865	10,415	1,465	1,904	4,864	1,317	865
1983	11,618	1,690	2,223	5,288	1,472	945	11,157	1,621	2,140	5,073	1,412	910
1984	12,883	1,861	2,608	5,709	1,675	1,030	11,922	1,720	2,421	5,277	1,548	956
1985	14,178	1,923	2,862	6,539	1,749	1,105	12,731	1,724	2,580	5,863	1,568	996
1986	16,570	2,019	4,046	7,476	1,859	1,170	14,498	1,763	3,555	6,529	1,623	1,028
1987	17,780	2,046	4,149	8,343	2,012	1,230	15,091	1,734	3,534	7,070	1,705	1,048
1988	18,460	2,050	3,988	8,870	2,222	1,330	15,193	1,686	3,288	7,295	1,827	1,097
1989	19,880	2,350	4,050	9,600	2,450	1,430	15,678	1,852	3,198	7,567	1,931	1,129
1990	21,490	2,400	4,200	10,570	2,750	1,570	16,255	1,814	3,183	7,990	2,079	1,190

1/ Based on GNP implicit price deflator.

SOURCE: National Science Foundation, SRS. Incorporates data available to SRS as of April 26, 1990.

Table B-9. Sources of funds for applied research by sector: 1953-90

(Dollars in millions)

	Current Dollars					Real (1982) Dollars 1/				
YEAR	UNITED STATES	FEDERAL GOVT.	INDUSTRY	UNIV. & COLLEGES	OTHER NONPROFIT	UNITED STATES	FEDERAL GOVT.	INDUSTRY	UNIV. & COLLEGES	OTHER NONPROFIT
1953	1,279	747	455	57	20	4,922	2,870	1,757	218	77
1954	1,390	798	512	59	21	5,280	3,030	1,947	224	80
1955	1,481	818	582	60	21	5,464	3,021	2,144	222	78
1956	1,889	988	817	59	25	6,740	3,529	2,911	211	89
1957	2,374	1,265	1,017	61	31	8,173	4,358	3,497	211	107
1958	2,699	1,439	1,163	61	36	9,089	4,843	3,920	205	121
1959	2,900	1,592	1,205	64	39	9,527	5,230	3,959	210	128
1960	3,020	1,688	1,226	66	40	9,743	5,441	3,961	212	129
1961	3,065	1,754	1,195	69	47	9,792	5,597	3,825	219	150
1962	3,665	2,067	1,470	70	58	11,469	6,466	4,602	219	182
1963	3,742	2,125	1,483	72	62	11,530	6,541	4,577	221	191
1964	4,128	2,397	1,593	77	61	12,521	7,266	4,837	233	185
1965	4,339	2,524	1,654	88	73	12,849	7,476	4,896	261	216
1966	4,601	2,582	1,841	89	89	13,188	7,411	5,266	256	255
1967	4,780	2,694	1,889	102	95	13,302	7,497	5,256	284	264
1968	5,130	2,809	2,125	97	99	13,664	7,506	5,633	261	264
1969	5,315	2,784	2,320	105	106	13,426	7,057	5,833	268	268
1970	5,738	3,097	2,427	99	115	13,714	7,426	5,775	239	275
1971	5,759	3,028	2,494	115	122	13,051	6,891	5,620	263	277
1972	6,011	3,131	2,615	140	125	12,972	6,773	5,625	304	270
1973	6,598	3,395	2,891	172	140	13,439	6,961	5,837	356	285
1974	7,189	3,495	3,332	203	159	13,482	6,617	6,177	389	299
1975	7,812	3,889	3,517	224	182	13,318	6,686	5,932	389	311
1976	8,983	4,471	4,003	282	227	14,328	7,163	6,348	454	363
1977	9,651	4,692	4,410	303	246	14,364	6,991	6,555	452	366
1978	10,725	5,110	4,981	354	280	14,888	7,107	6,898	494	389
1979	12,268	5,772	5,796	407	293	15,662	7,387	7,378	522	374
1980	13,855	6,410	6,694	438	313	16,226	7,532	7,810	517	367
1981	16,607	7,203	8,535	529	340	17,719	7,703	9,085	568	363
1982	18,512	7,977	9,567	606	362	18,512	7,977	9,567	606	362
1983	20,698	9,184	10,507	620	387	19,908	8,826	10,116	595	372
1984	22,850	9,932	11,810	699	409	21,186	9,199	10,962	646	379
1985	25,830	11,405	13,218	755	452	23,249	10,254	11,913	677	406
1986	27,550	10,785	15,444	856	465	24,169	9,446	13,568	748	407
1987	28,976	11,353	16,140	956	527	24,650	9,645	13,747	810	448
1988	30,897	12,133	17,055	1,097	612	25,459	9,991	14,062	902	504
1989	32,290	12,720	17,705	1,210	655	25,486	10,035	13,980	954	517
1990	33,785	12,965	18,670	1,380	770	25,584	9,812	14,146	1,043	583

1/ Based on GNP implicit price deflator.

SOURCE: National Science Foundation, SRS. Incorporates data available to SRS as of April 26, 1990.

Table B-10. Applied research performance by sector: 1953-90

(Dollars in millions)

	Current Dollars						Real (1982) Dollars 1/					
YEAR	UNITED STATES	FEDERAL GOVT.	INDUSTRY	UNIV. & COLLEGES	U&C FFRDCs	OTHER NONPROFIT	UNITED STATES	FEDERAL GOVT.	INDUSTRY	UNIV. & COLLEGES	U&C FFRDCs	OTHER NONPROFIT
1953	1,279	345	726	130	44	34	4,922	1,321	2,804	498	168	131
1954	1,390	349	814	137	51	39	5,280	1,324	3,095	520	193	148
1955	1,481	310	928	136	65	42	5,464	1,148	3,418	503	241	155
1956	1,889	356	1,268	147	71	47	6,740	1,275	4,517	526	254	167
1957	2,374	417	1,670	145	86	56	8,173	1,440	5,743	501	297	193
1958	2,699	474	1,911	148	102	64	9,089	1,592	6,441	497	343	216
1959	2,900	558	1,991	155	119	77	9,527	1,833	6,541	509	391	253
1960	3,020	595	2,029	179	122	95	9,743	1,913	6,556	575	392	307
1961	3,065	634	1,977	192	135	127	9,792	2,017	6,328	611	429	407
1962	3,665	702	2,449	205	155	154	11,469	2,194	7,668	641	484	482
1963	3,742	715	2,457	227	170	173	11,530	2,194	7,583	697	522	534
1964	4,128	903	2,600	232	202	191	12,521	2,732	7,896	702	611	580
1965	4,339	990	2,658	279	204	208	12,849	2,933	7,869	827	604	616
1966	4,601	997	2,843	328	207	226	13,188	2,870	8,132	944	596	646
1967	4,780	1,027	2,915	374	219	245	13,302	2,859	8,111	1,041	610	682
1968	5,130	1,110	3,124	403	231	262	13,664	2,985	8,280	1,084	621	694
1969	5,315	1,113	3,287	407	210	298	13,426	2,840	8,263	1,038	536	749
1970	5,738	1,345	3,427	427	216	323	13,714	3,242	8,154	1,029	521	768
1971	5,759	1,322	3,415	474	210	338	13,051	3,028	7,695	1,086	481	762
1972	6,011	1,387	3,514	524	221	365	12,972	3,011	7,559	1,138	480	785
1973	6,598	1,480	3,825	713	227	353	13,439	3,061	7,721	1,475	469	713
1974	7,189	1,574	4,288	736	178	413	13,482	3,018	7,947	1,411	341	765
1975	7,812	1,730	4,570	851	213	448	13,318	3,007	7,705	1,479	370	755
1976	8,983	2,093	5,112	1,016	264	498	14,328	3,371	8,105	1,637	425	790
1977	9,651	2,044	5,636	1,067	371	533	14,364	3,049	8,377	1,592	553	792
1978	10,725	2,191	6,300	1,213	431	590	14,888	3,055	8,723	1,691	601	817
1979	12,268	2,392	7,225	1,473	468	710	15,662	3,071	9,196	1,891	601	904
1980	13,855	2,484	8,450	1,693	503	725	16,226	2,931	9,858	1,998	594	846
1981	16,607	2,732	10,699	1,867	529	780	17,719	2,931	11,387	2,003	568	830
1982	18,512	2,729	12,323	2,039	606	815	18,512	2,729	12,323	2,039	606	815
1983	20,698	3,020	13,927	2,150	726	875	19,908	2,897	13,409	2,063	697	842
1984	22,850	2,903	15,765	2,463	804	915	21,186	2,683	14,634	2,277	743	849
1985	25,830	3,133	18,255	2,672	835	935	23,249	2,809	16,453	2,396	749	843
1986	27,550	3,141	19,741	2,909	774	985	24,169	2,743	17,344	2,540	676	865
1987	28,976	3,392	20,671	3,155	693	1,065	24,650	2,874	17,607	2,674	587	907
1988	30,897	3,288	21,868	3,909	697	1,135	25,459	2,704	18,031	3,215	573	936
1989	32,290	3,550	22,700	4,140	720	1,180	25,486	2,798	17,925	3,263	568	932
1990	33,785	3,550	23,800	4,445	740	1,250	25,584	2,683	18,034	3,360	559	947

1/ Based on GNP implicit price deflator.

SOURCE: National Science Foundation, SRS. Incorporates data available to SRS as of April 26, 1990.

Table B-11. Sources of funds for development by sector: 1953-90

(Dollars in millions)

	Current Dollars					Real (1982) Dollars 1/				
YEAR	UNITED STATES	FEDERAL GOVT.	INDUSTRY	UNIV. & COLLEGES	OTHER NONPROFIT	UNITED STATES	FEDERAL GOVT.	INDUSTRY	UNIV. & COLLEGES	OTHER NONPROFIT
1953	3,404	1,755	1,637	5	7	13,126	6,757	6,323	19	27
1954	3,758	2,051	1,693	6	8	14,283	7,792	6,437	23	30
1955	4,144	2,382	1,747	7	8	15,274	8,784	6,435	26	29
1956	5,795	3,503	2,277	7	8	20,657	12,492	8,112	25	29
1957	6,621	4,418	2,184	9	10	22,780	15,204	7,510	31	34
1958	7,135	4,862	2,252	10	11	24,038	16,377	7,590	34	37
1959	8,418	5,827	2,569	10	12	27,655	19,143	8,440	33	39
1960	9,306	6,335	2,948	11	12	30,049	20,450	9,525	35	39
1961	9,850	6,622	3,201	11	16	31,505	21,172	10,246	35	51
1962	10,005	6,713	3,259	13	20	31,317	21,010	10,203	41	63
1963	11,352	7,768	3,548	14	22	35,010	23,949	10,951	43	68
1964	12,437	8,542	3,861	14	20	37,747	25,919	11,725	42	61
1965	13,150	8,679	4,433	15	23	38,934	25,698	13,123	44	68
1966	14,431	9,408	4,977	18	28	41,317	26,949	14,236	52	80
1967	15,310	9,500	5,761	20	29	42,601	26,435	16,029	56	81
1968	16,178	9,782	6,345	17	34	42,965	26,012	16,817	46	90
1969	16,873	9,668	7,150	17	38	42,498	24,385	17,974	43	96
1970	16,865	9,323	7,489	13	40	40,206	22,260	17,818	31	95
1971	17,265	9,427	7,781	14	43	39,003	21,341	17,533	32	97
1972	18,664	10,071	8,532	19	42	40,206	21,722	18,352	41	90
1973	20,175	10,296	9,797	33	49	40,878	20,934	19,776	68	99
1974	21,331	10,338	10,895	42	56	39,728	19,351	20,191	81	105
1975	22,663	10,951	11,598	47	67	38,388	18,637	19,555	82	114
1976	24,905	11,854	12,922	52	77	39,574	18,880	20,489	84	122
1977	27,397	12,881	14,369	58	89	40,741	19,165	21,357	87	132
1978	30,711	14,020	16,505	78	108	42,565	19,453	22,854	109	150
1979	35,110	15,707	19,194	84	125	44,738	20,041	24,429	108	159
1980	40,317	17,144	22,948	92	133	47,100	20,065	26,771	109	156
1981	45,664	19,594	25,822	108	140	48,647	20,899	27,482	116	149
1982	51,074	21,507	29,293	120	154	51,074	21,507	29,293	120	154
1983	56,810	23,882	32,624	134	170	54,675	22,972	31,411	129	164
1984	65,383	27,225	37,829	146	183	60,660	25,241	35,115	135	170
1985	73,737	31,488	41,876	165	208	66,416	28,338	37,743	148	187
1986	75,743	33,850	41,489	194	210	66,493	29,688	36,451	169	184
1987	80,560	36,268	43,831	219	242	68,576	30,850	37,335	186	206
1988	85,874	38,687	46,671	241	275	70,782	31,876	38,482	198	227
1989	89,830	40,880	48,380	270	300	70,916	32,264	38,203	213	237
1990	94,725	42,985	51,100	300	340	71,753	32,548	38,721	227	257

1/ Based on GNP implicit price deflator.

SOURCE: National Science Foundation, SRS. Incorporates data available to SRS as of April 26, 1990.

Table B-12. Development performance by sector: 1953-90

(Dollars in millions)

	Current Dollars						Real (1982) Dollars 1/					
YEAR	UNITED STATES	FEDERAL GOVT.	INDUSTRY	UNIV. & COLLEGES	U&C FFRDCs	OTHER NONPROFIT	UNITED STATES	FEDERAL GOVT.	INDUSTRY	UNIV. & COLLEGES	U&C FFRDCs	OTHER NONPROFIT
1953	3,404	564	2,753	15	44	28	13,126	2,159	10,633	57	168	108
1954	3,758	569	3,090	17	51	31	14,283	2,158	11,749	64	193	118
1955	4,144	505	3,523	17	66	33	15,274	1,869	12,976	63	244	122
1956	5,795	580	5,084	25	72	34	20,657	2,077	18,112	90	258	121
1957	6,621	681	5,790	25	89	36	22,780	2,352	19,911	86	307	124
1958	7,135	774	6,183	27	113	38	24,038	2,600	20,839	91	380	128
1959	8,418	909	7,307	28	127	47	27,655	2,986	24,005	92	417	154
1960	9,306	971	8,104	34	141	56	30,049	3,122	26,184	109	453	181
1961	9,850	1,034	8,536	35	160	85	31,505	3,289	27,324	111	509	272
1962	10,005	1,145	8,527	40	179	114	31,317	3,578	26,697	125	559	357
1963	11,352	1,309	9,651	40	201	151	35,010	4,017	29,787	123	617	466
1964	12,437	1,621	10,363	40	236	177	37,747	4,905	31,470	121	714	538
1965	13,150	1,739	10,935	57	217	202	38,934	5,153	32,371	169	643	598
1966	14,431	1,838	12,081	84	196	232	41,317	5,291	34,557	242	564	664
1967	15,310	1,934	12,841	90	204	241	42,601	5,383	35,729	251	568	671
1968	16,178	1,952	13,663	96	212	255	42,965	5,249	36,213	258	570	676
1969	16,873	1,856	14,403	107	240	267	42,498	4,735	36,207	273	612	671
1970	16,865	2,175	14,038	112	252	288	40,206	5,243	33,400	270	607	685
1971	17,265	2,340	14,315	112	246	252	39,003	5,359	32,256	257	563	568
1972	18,664	2,605	15,445	84	288	242	40,206	5,656	33,222	182	625	521
1973	20,175	2,674	16,793	118	294	296	40,878	5,531	33,898	244	608	597
1974	21,331	2,641	17,900	133	297	360	39,728	5,064	33,173	255	569	667
1975	22,663	2,890	18,887	148	335	403	38,388	5,024	31,845	257	582	679
1976	24,905	2,890	21,066	164	371	414	39,574	4,655	33,401	264	598	656
1977	27,397	3,054	23,278	200	413	452	40,741	4,556	34,599	298	616	672
1978	30,711	3,590	25,969	236	419	497	42,565	5,006	35,958	329	584	688
1979	35,110	3,937	29,843	274	452	604	44,738	5,054	37,983	352	580	769
1980	40,317	3,966	34,730	337	619	665	47,100	4,680	40,516	398	730	776
1981	45,664	4,392	39,497	384	696	695	48,647	4,712	42,036	412	747	740
1982	51,074	4,947	44,423	403	556	745	51,074	4,947	44,423	403	556	745
1983	56,810	5,872	49,118	426	539	855	54,675	5,634	47,293	409	517	823
1984	65,383	6,808	56,427	422	671	1,055	60,660	6,293	52,378	390	620	979
1985	73,737	7,889	63,122	452	939	1,335	66,416	7,073	56,892	405	842	1,203
1986	75,743	8,375	64,392	519	1,262	1,195	66,493	7,314	56,574	453	1,102	1,050
1987	80,560	7,975	69,297	582	1,501	1,205	68,576	6,758	59,026	493	1,272	1,026
1988	85,874	8,943	73,566	643	1,612	1,110	70,782	7,355	60,658	529	1,326	915
1989	89,830	9,900	76,250	710	1,680	1,290	70,916	7,804	60,210	560	1,324	1,019
1990	94,725	10,750	80,150	785	1,760	1,280	71,753	8,126	60,734	593	1,330	970

1/ Based on GNP implicit price deflator.

SOURCE: National Science Foundation, SRS. Incorporates data available to SRS as of April 26, 1990.

Table B-13. Trends in Federal and non-Federal R&D outlays:
1953-90
(percent)

	Federal				
Year	Total	Defense related	Space related	Civilian related	Non-Federal
1953	54%	48%	1%	5%	46%
1954	55	49	1	6	45
1955	57	48	1	8	43
1956	58	49	1	8	42
1957	63	53	1	9	37
1958	63	53	1	10	37
1959	65	54	3	8	35
1960	65	52	3	9	35
1961	65	50	6	9	35
1962	64	48	7	9	36
1963	66	41	14	11	34
1964	66	37	19	9	34
1965	65	33	21	11	35
1966	64	33	19	12	36
1967	62	35	14	13	38
1968	61	35	13	13	39
1969	58	34	11	13	42
1970	57	33	10	14	43
1971	56	32	9	15	44
1972	56	32	9	15	44
1973	53	30	8	15	47
1974	51	30	7	14	49
1975	51	29	8	15	49
1976	51	28	8	16	49
1977	50	28	7	16	50
1978	50	27	6	17	50
1979	49	26	6	18	51
1980	47	25	5	17	53
1981	46	25	5	16	54
1982	46	27	5	14	54
1983	46	28	4	14	54
1984	45	29	4	12	55
1985	46	30	4	12	54
1986	46	30	4	12	54
1987	46	28	4	14	54
1988	46	28	4	14	54
1989	46	28	5	13	54
1990	46	28	5	13	54

NOTE: Data estimated for 1989 and 1990. Because of rounding, detail may not add to 100.

SOURCE: National Science Foundation, SRS

Table B-14. National expenditures for
performance of R&D as a percent of
gross national product (GNP) by source:
1953-90
(percent)

Year	Total	Federal	Non-Federal
1953	1.38%	0.74%	0.64%
1954	1.52	0.84	0.67
1955	1.52	0.86	0.66
1956	1.95	1.13	0.82
1957	2.17	1.35	0.81
1958	2.34	1.48	0.86
1959	2.49	1.62	0.87
1960	2.62	1.70	0.93
1961	2.68	1.73	0.95
1962	2.68	1.72	0.95
1963	2.81	1.85	0.96
1964	2.90	1.93	0.97
1965	2.84	1.85	1.00
1966	2.83	1.81	1.02
1967	2.84	1.76	1.07
1968	2.76	1.67	1.08
1969	2.66	1.54	1.11
1970	2.57	1.47	1.11
1971	2.42	1.36	1.06
1972	2.35	1.30	1.04
1973	2.26	1.21	1.05
1974	2.23	1.14	1.09
1975	2.20	1.13	1.07
1976	2.19	1.12	1.07
1977	2.15	1.08	1.06
1978	2.14	1.06	1.08
1979	2.19	1.07	1.12
1980	2.29	1.08	1.21
1981	2.35	1.09	1.26
1982	2.53	1.16	1.37
1983	2.62	1.20	1.42
1984	2.68	1.21	1.47
1985	2.83	1.30	1.54
1986	2.83	1.29	1.54
1987	2.81	1.29	1.52
1988	2.77	1.27	1.50
1989	2.71	1.26	1.45
1990	2.69	1.24	1.45

NOTE: Data estimated for 1989 and 1990.

SOURCE: National Science Foundation, SRS
and Department of Commerce

Table B-15. Estimated full-time equivalent (FTE) scientists and engineers employed in research and development by sector, and the labor force population: selected years
(In thousands)

	Research and development scientists and engineers 1/								Ratio of R&D S&Es to labor force 7/
				Universities and colleges					
Year	United States	Federal government 2/	Industry 3/	Total	Scientists & engineers 4/	Graduate students 5/	Other nonprofit institutions 6/	Labor force	
1954	237.0	37.7	164.1	29.9	25.2	4.7	5.3	65,785	36.0
1961	425.4	51.1	312.0	51.2	42.4	8.8	11.1	72,359	58.8
1968	549.9	68.1	381.9	76.7	59.7	17.0	23.2	80,990	67.9
1969	552.7	66.5	385.6	79.4	61.5	17.9	21.2	82,972	66.6
1970	543.8	67.5	375.6	79.5	61.3	18.2	21.2	84,889	64.1
1971	523.5	63.9	358.6	79.4	60.8	18.6	21.6	86,355	60.6
1972	515.0	61.4	354.0	77.8	60.2	17.6	21.8	88,847	58.0
1973	514.6	58.2	358.9	75.2	58.6	16.6	22.3	91,203	56.4
1974	520.6	58.3	361.7	77.3	59.8	17.5	23.3	93,670	55.6
1975	527.4	58.4	363.9	82.1	63.5	18.6	23.0	95,453	55.3
1976	535.2	53.3	373.6	84.8	65.9	18.9	23.5	97,826	54.7
1977	560.6	55.0	393.6	88.0	68.0	20.0	24.0	100,665	55.7
1978	586.6	57.1	414.2	90.3	69.7	20.6	25.0	103,882	56.5
1979	614.5	57.4	437.3	92.3	70.6	21.7	27.5	106,559	57.7
1980	651.2	58.6	469.2	95.9	72.7	23.2	27.5	108,544	60.0
1981	683.3	59.2	498.8	98.3	73.9	24.4	27.0	110,315	61.9
1982	711.9	60.0	525.4	99.5	74.5	25.0	27.0	111,872	63.6
1983	751.7	61.3	562.5	100.4	75.5	24.9	27.5	113,226	66.4
1984	797.8	62.1	603.3	103.4	77.3	26.1	29.0	115,241	69.2
1985	849.2	62.9	646.8	108.5	81.1	27.4	31.0	117,167	72.5
1986	896.5	63.3	684.2	118.0	89.1	28.9	31.0	119,540	75.0
1987	923.3	62.3	703.0	126.5	95.2	31.3	31.5	121,602	75.9
1988	949.2	65.8	716.8	135.1	101.8	33.3	31.5	123,378	76.9

1/ Based on surveys of employers. Number of full-time employees plus the FTE of part-time employees. Excludes scientists and engineers employed in State and local government agencies.

2/ Includes both civilian and military service personnel and managers of research and development (R&D). Data are for persons primarily employed in R&D. Since 1987, excludes scientists and engineers with less than a bachelors degree.

3/ Industry sector figures include professional R&D personnel employed at industry-administered federally funded research and development centers (FFRDCs). Excludes social scientists.

4/ Last survey of university sector was for 1985. Since then, estimates based on 1985 survey data. All figures include R&D personnel employed at university-associated FFRDCs (15,300 in 1985).

5/ Numbers of FTE graduate students receiving stipends and engaged in R&D. Figures include graduate students working in university-associated FFRDCs. Since 1980, full-time science and engineering graduate students with research assistantships have averaged an estimated 47% of their time engaged in R&D activities.

6/ Last survey of nonprofits sector was for 1973. Since then, estimates based on survey data from the early seventies and trends in the national R&D expenditures/FTE R&D scientists and engineers ratio. Includes professional R&D personnel employed at FFRDCs administered by organizations in the sector.

7/ Number of FTE scientists and engineers employed in R&D activities per 10,000 labor force population.

SOURCES: National Science Foundation, SRS, and Department of Labor (See Appendix A, technical notes.)

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Table B-16. Geographic distribution of research & development performance, by sector: 1987

(dollars in millions)

	Total	Industry	Federal Govt.	Univ. & Colleges	Other**
United States	$127,862	$94,282	$13,413	$16,284	$3,883
Northeast	$32,120	$25,654	$1,561	$3,792	$1,112
New England	11,340	8,324	862	1,482	671
Connecticut	2,474	2,216	18	231	9
Maine	79	41	5	17	15
Massachusetts	7,772	5,492	576	1,073	632
New Hampshire	161	94	19	48	0
Rhode Island	554	234	240	66	15
Vermont	283	247	4	32	0
Middle Atlantic	20,780	17,330	700	2,310	441
New Jersey	6,728	6,141	255	323	9
New York	8,403	6,559	160	1,351	333
Pennsylvania	5,631	4,630	284	619	98
South	27,685	16,656	6,913	3,648	468
South Atlantic	17,256	9,208	5,615	2,080	354
Delaware	884-1,030*	846-992*	3	32	3
D.C.	1,432-1,578*	39-185*	1,208	85	100
Florida	3,123	2,133	719	252	19
Georgia	1,429	1,001	96	324	8
Maryland	4,609	1,350	2,507	710	41
North Carolina	2,219	1,741	130	314	35
South Carolina	649	523	12	96	18
Virginia	2,561	1,342	884	207	129
West Virginia	188	87	57	44	1
Southeast	3,903	2,534	864	461	43
Alabama	2,352	1,592	584	153	23
Kentucky	356	249	27	78	2
Mississippi	234	44	127	58	5
Tennessee	941	649	126	153	13
Southwest	6,526	4,914	433	1,107	71
Arkansas	196	135	24	36	1
Louisiana	321	134	35	149	3
Oklahoma	534	384	34	99	17
Texas	5,462	4,261	341	811	49
North Central	$28,821	$24,224	$1,387	$2,994	$217
Great Lakes	21,984	18,429	1,237	2,170	148
Illinois	5,369	4,284	73	942	70
Indiana	2,197	1,944	64	188	1
Michigan	7,922	7,415	87	397	23
Ohio	4,936	3,569	991	329	47
Wisconsin	1,549	1,217	22	303	7
Plains	6,837	5,795	150	824	68
Iowa	540	343	20	177	0
Kansas	1,288	1,179	9	94	6
Minnesota	2,533	2,242	26	222	42
Missouri	2,174	1,905	46	207	16
Nebraska	158	62	22	72	2
North Dakota	120	60	20	39	1
South Dakota	23	4	6	12	1
West	$36,902	$27,387	$3,075	$5,773	$666
Mountain	7,067	4,464	854	1,632	117
Arizona	1,145	845	83	207	10
Colorado	1,705	1,261	133	238	73
Idaho	532	488	15	25	4
Montana	55	7	18	30	0
Nevada	168	57	77	28	6
New Mexico	2,388	993	421	963	11
Utah	1,034	809	99	121	5
Wyoming	36	4	8	17	7
Pacific	29,835	22,923	2,221	4,141	549
Alaska	86	10	33	30	13
California	25,557	19,475	2,011	3,649	422
Hawaii	159	73	23	57	5
Oregon	474	294	32	132	16
Washington	3,523	3,071	122	236	93
Undistributed	$2,333	$361	$477	$76	$1,419

* For the industry sector, reported data fall within the range specified, but have been withheld by the Census Bureau to avoid disclosing individual company operations. Range for state total is R&D performance of Federal government, universities and colleges, and other sector, plus the low and high ends of the industry R&D performance range.

**For other sector, funds distributed by State include only Federal obligations to organizations in the nonprofit sector ($2,081 million) and all State governments' intramural R&D performance ($383 million). Nonprofit R&D performance using non-Federal funds are undistributed. Zero figures represent expenditures of less than $0.5 million.

SOURCE: National Science Foundation, SRS. See Appendix A, Technical Notes.

Table B-17. Scientists and engineers engaged in R&D per 10,000 labor force population by country: 1965-88

Year	France	West Germany	Japan	United Kingdom	United States
1965	21.0	22.6	24.6	19.6	64.7
1966	29.2	22.3	26.4	NA	NA
1967	25.3	24.4	27.8	NA	NA
1968	26.2	25.9	31.1	20.8	67.9
1969	27.1	28.2	30.8	NA	66.6
1970	27.3	30.8	33.4	NA	64.1
1971	27.9	33.4	37.5	NA	60.6
1972	28.2	35.6	38.1	30.4	58.0
1973	28.5	37.1	42.5	NA	56.4
1974	28.8	37.8	44.9	NA	55.6
1975	29.2	38.6	47.9	31.1	55.3
1976	29.6	39.2	48.4	NA	54.7
1977	29.7	41.8	49.9	NA	55.7
1978	30.7	42.7	49.4	33.3	56.5
1979	31.6	43.4	50.4	NA	57.7
1980	32.1	44.3	53.6	NA	60.0
1981	36.3	45.5	55.6	35.8	61.9
1982	37.9	46.4	57.1	NA	63.6
1983	39.1	47.4	58.1	35.4	66.4
1984	41.1	49.6	62.4	35.5	69.2
1985	42.8	51.6	63.9	35.5	72.5
1986	43.8	52.3	67.4	35.5	75.0
1987	44.9	53.7	68.8	35.9	75.9
1988	NA	NA	NA	NA	76.9

NOTE: In general, includes all scientists and engineers engaged in R&D on a full-time-equivalent basis. For Japan, data include persons primarily employed in R&D. For U.S., underlying data for government sector include persons primarily employed in R&D. For the United Kingdom, data include only the government and industry sectors.

NA = Not available.

SOURCES: National Science Foundation, SRS, U.S. Department of Labor, and Organisation for Economic Co-operation and Development.

Table B-18. National expenditures for performance of R&D as a percent of gross national product by country: 1961-88
(percent)

Year	France	West Germany	Japan	United Kingdom	United States
1961	1.4%	NA	1.4%	2.5%	2.7%
1962	1.5	1.2	1.5	NA	2.8
1963	1.6	1.4	1.5	NA	2.9
1964	1.8	1.6	1.5	2.3	2.8
1965	2.0	1.7	1.6	NA	2.8
1966	2.1	1.8	1.5	2.3	2.8
1967	2.1	2.0	1.5	2.3	2.8
1968	2.1	2.0	1.7	2.2	2.8
1969	2.0	1.8	1.7	2.3	2.7
1970	1.9	2.1	1.9	NA	2.6
1971	1.9	2.2	1.9	NA	2.4
1972	1.9	2.2	1.9	2.1	2.3
1973	1.8	2.1	2.0	NA	2.3
1974	1.8	2.1	2.0	NA	2.2
1975	1.8	2.2	2.0	2.1	2.2
1976	1.8	2.1	2.0	NA	2.2
1977	1.8	2.1	2.0	NA	2.1
1978	1.8	2.2	2.0	2.2	2.1
1979	1.8	2.4	2.1	NA	2.2
1980	1.8	2.4	2.2	NA	2.3
1981	2.0	2.5	2.3	2.4	2.4
1982	2.1	2.6	2.4	NA	2.5
1983	2.1	2.6	2.6	2.2	2.6
1984	2.2	2.6	2.6	NA	2.7
1985	2.3	2.8	2.8	2.3	2.8
1986	2.3	2.7	2.8	2.4	2.8
1987	2.3	2.8	2.8	2.3	2.8
1988	2.3	2.8	2.9	2.2	2.8

NOTE: NA = Not available.

SOURCES: National Science Foundation, SRS, and Organisation for Economic Co-operation and Development.

Table B-19. Estimated nondefense R&D expenditures as a percent of gross national product by country 1/: 1971-88
(percent)

Year	France	West Germany	Japan	United Kingdom	United States
1971	1.5%	2.0%	1.9%	NA	1.6%
1972	1.5	2.1	1.9	1.5	1.6
1973	1.4	1.9	2.0	NA	1.6
1974	1.4	2.0	2.0	NA	1.6
1975	1.5	2.1	2.0	1.5	1.6
1976	1.4	2.0	2.0	NA	1.6
1977	1.4	2.0	2.0	NA	1.6
1978	1.4	2.1	2.0	1.6	1.6
1979	1.4	2.3	2.1	NA	1.6
1980	1.4	2.3	2.2	NA	1.7
1981	1.5	2.4	2.3	1.7	1.8
1982	1.6	2.5	2.4	NA	1.9
1983	1.7	2.5	2.5	1.6	1.9
1984	1.7	2.4	2.6	NA	1.9
1985	1.8	2.5	2.8	1.6	2.0
1986	1.8	2.5	2.8	1.7	2.0
1987	1.8	2.7	2.8	1.7	2.0
1988	1.8	2.6	2.9	1.7	2.0

1/ National R&D expenditures, excluding government funds for defense.

NOTE: NA = Not available.

SOURCES: National Science Foundation, SRS, and Organisation for Economic Co-operation and Development.

TABLE B-20. FEDERAL OBLIGATIONS FOR RESEARCH AND DEVELOPMENT, BY AGENCY: FISCAL YEARS 1981-90

(THOUSANDS OF DOLLARS)

FISCAL YEAR	1981	1982	1983	1984	1985	1986	1987	1988	ESTIMATES	
									1989	1990
TOTAL, ALL AGENCIES ..	33,103,924	36,432,589	38,711,537	42,224,865	48,359,565	51,412,364	55,253,058	56,935,073	61,902,039	66,084,038
DEPT OF AGRIC, TOTAL .	773,958	797,274	847,605	866,171	942,979	928,528	947,858	1,016,627	1,049,264	1,045,205
FOREST SERVICE	126,055	112,145	107,672	108,359	113,143	113,317	126,721	135,500	137,900	142,500
OTHER AGRICULTURE ..	647,903	685,129	739,933	757,812	829,836	815,211	821,137	881,127	911,364	902,705
DEPT OF COMMERCE, TOTAL	327,925	336,278	334,992	358,226	398,759	399,166	402,240	388,949	405,529	310,358
NATIONAL INSTITUTE OF STAND & TECH	82,518	88,837	95,031	95,531	100,534	100,787	98,638	107,947	123,388	118,441
NATIONAL OCEANIC & ATMOS ADMIN	201,351	222,026	222,037	244,300	269,788	274,665	286,100	263,000	267,622	178,117
OTHER COMMERCE	44,056	25,415	17,924	18,395	28,437	23,714	17,502	18,002	14,519	13,800
DEPT OF DEFENSE, TOTAL	16,508,649	20,622,574	22,992,789	25,372,870	29,791,504	32,937,939	35,231,532	35,415,140	37,630,437	40,242,013
ARMY	3,244,159	3,760,489	3,998,085	4,225,532	4,570,793	4,809,370	5,019,479	4,806,045	5,350,948	5,843,107
NAVY	5,005,952	5,845,056	6,068,206	7,605,590	9,127,432	9,650,289	9,507,786	9,514,060	9,617,524	10,372,560
AIR FORCE	6,969,247	9,357,858	10,812,616	12,091,645	13,260,917	13,593,790	15,347,684	15,033,591	15,266,681	15,068,726
DEFENSE AGENCIES ...	1,248,240	1,618,134	2,052,300	1,391,540	2,781,724	4,767,388	5,219,670	5,832,935	7,188,477	8,538,038
OTHER DEFENSE	41,051	41,037	61,582	58,563	50,638	117,102	136,913	228,509	206,807	419,582
DEPT OF EDUCATION	104,862	127,981	111,681	115,702	124,866	121,308	132,516	140,683	161,066	143,872
DEPT OF ENERGY	4,918,225	4,708,158	4,536,682	4,673,578	4,966,008	4,688,304	4,757,202	5,036,400	5,478,855	5,282,044
DEPT OF HEALTH & HUMAN SERVICES, TOTAL ..	3,927,141	3,940,745	4,352,530	4,830,693	5,451,036	5,657,604	6,606,289	7,158,041	7,887,995	8,375,908
NAT'L INST OF HEALTH	3,333,249	3,433,148	3,789,222	4,257,436	4,827,737	5,005,100	5,850,857	6,290,898	6,791,700	7,177,200
OTHER HHS	593,892	507,597	563,308	573,257	623,299	652,504	755,432	867,143	1,096,295	1,198,708
DEPT OF HOUSING & URBAN DEV	48,108	28,855	32,090	18,236	18,532	15,304	16,279	18,412	18,219	21,795
DEPT OF THE INTERIOR, TOTAL	427,105	381,074	382,473	410,877	391,685	385,219	403,834	416,768	432,302	387,562
BUREAU OF MINES	96,744	94,707	88,533	108,777	89,874	84,350	88,832	91,341	102,280	72,335
GEOLOGICAL SURVEY ..	169,777	152,560	157,004	208,881	214,906	218,620	226,799	236,147	240,035	231,760
OTHER INTERIOR	160,584	133,807	136,936	93,219	86,905	82,249	88,203	89,280	89,987	83,467
DEPT OF JUSTICE	26,527	26,692	31,376	24,520	35,992	36,460	42,372	43,118	40,175	34,656
DEPT OF LABOR	62,188	25,410	19,877	16,259	13,287	10,394	21,596	35,607	32,501	35,989
DEPT OF STATE	1,766	1,549	1,488	1,550	1,482	1,464	2,962	4,159	4,128	3,205
DEPT OF TRANS, TOTAL .	415,539	310,083	347,728	448,335	428,859	385,474	324,345	303,954	334,985	330,134
FED AVIATION ADMIN .	120,000	94,300	126,200	266,182	286,300	260,600	167,308	160,535	179,559	181,323
OTHER TRANSPORTATION	295,539	215,783	221,528	182,153	142,559	124,874	157,037	143,419	155,426	148,811
DEPT OF THE TREASURY .	11,306	13,323	15,583	13,853	24,305	24,011	26,876	26,054	29,802	31,144
DEPT OF VETERANS AFFAIRS	144,400	137,300	161,400	190,300	226,600	186,200	209,500	215,300	235,600	203,400
OTHER AGENCIES										
ENVIRON'L PROTECTION AGENCY	325,700	335,089	240,709	261,172	320,413	317,319	348,244	347,430	385,913	420,727
NAT'L AERONAUTICS & SPACE ADMIN	3,593,155	3,077,859	2,661,579	2,821,900	3,327,200	3,419,800	3,787,072	4,330,358	5,688,358	6,870,364
NAT'L SCI FOUNDATION .	961,564	975,327	1,061,990	1,202,820	1,345,583	1,353,335	1,470,505	1,532,773	1,663,608	1,880,995
NUCLEAR REGULATORY COMMISSION	219,667	220,287	207,295	190,675	149,959	123,785	122,468	108,480	115,884	129,966
ALL OTHER	306,139	366,731	371,670	407,128	400,516	420,750	399,368	396,820	307,418	334,701

SOURCE: NATIONAL SCIENCE FOUNDATION, SRS

Table B-21. Federal R&D funding by budget function: fiscal years 1982-90
[Dollars in millions]

Function	1982	1983	1984	1985	1986	1987	1988	1989	1990 est
Total	$36,115	$38,768	$44,214	$49,887	$53,249	$57,069	$59,106	$62,115	$63,805
National defense	22,070	24,936	29,287	33,698	36,926	39,152	40,099	40,642	39,877
Health	3,869	4,298	4,779	5,418	5,565	6,556	7,076	7,773	8,358
Space research and technology	2,584	2,134	2,300	2,725	2,894	3,398	3,683	4,555	5,577
General science	1,359	1,502	1,676	1,862	1,873	2,042	2,160	2,373	2,499
Energy	3,012	2,578	2,581	2,389	2,286	2,053	2,126	2,419	2,991
Natural resources and environment	965	952	963	1,059	1,062	1,133	1,160	1,255	1,362
Transportation	791	876	1,040	1,030	917	908	896	1,064	1,144
Agriculture	693	745	762	836	815	822	882	907	949
Education, training, employment and social services	228	189	200	220	248	267	285	347	390
International affairs	165	177	192	210	211	223	224	279	212
Veterans benefits and services	139	157	218	193	183	215	195	212	215
Commerce and housing credit	104	107	110	114	111	110	122	128	139
Community and regional development	63	44	46	50	88	99	108	74	77
Administration of justice	31	37	24	47	41	49	51	45	44
Income security	32	32	26	21	14	25	23	27	35
General government	10	6	8	17	14	17	17	15	17

Note: Data for 1982-89 are actual budget authority. Data for 1990 are estimates based on the FY 1991 budget.

SOURCE: National Science Foundation, SRS

TABLE 22. FEDERAL OBLIGATIONS FOR BASIC RESEARCH BY AGENCY: FISCAL YEARS 1981-90

(THOUSANDS OF DOLLARS)

AGENCY AND SUBDIVISION	1981	1982	1983	1984	1985	1986	1987	1988	ESTIMATES	
									1989	1990
TOTAL, ALL AGENCIES ..	5,041,295	5,481,605	6,260,131	7,067,359	7,818,682	8,153,076	8,942,425	9,473,618	10,464,433	11,200,587
DEPT OF AGRICULTURE ..	314,128	330,755	362,019	392,649	445,388	432,857	445,464	480,588	491,427	511,949
DEPT OF COMMERCE	16,204	16,867	19,221	20,613	23,227	26,523	25,779	30,858	32,048	31,271
DEPT OF DEFENSE, TOTAL	604,285	686,684	785,620	847,857	861,407	923,915	907,599	876,922	908,313	964,174
ARMY	148,089	187,662	208,320	222,090	240,753	248,450	216,972	165,727	174,857	207,374
NAVY	238,000	280,300	305,400	315,765	343,110	337,267	354,255	341,805	343,972	390,267
AIR FORCE	125,800	145,800	164,200	192,359	198,298	216,483	221,584	196,382	188,274	215,801
DEFENSE AGENCIES ...	92,396	72,922	107,700	117,643	79,246	121,715	114,788	173,008	201,210	150,732
OTHER DEFENSE	-	-	-	-	-	-	-	-	-	-
DEPT OF EDUCATION	20,576	14,199	14,182	12,221	14,642	4,522	3,119	4,354	4,381	4,438
DEPT OF ENERGY	586,340	642,211	767,718	830,432	942,592	959,668	1,068,465	1,184,808	1,313,873	1,394,229
DEPT OF HEALTH & HUMAN SERVICES, TOTAL ..	1,900,384	2,144,694	2,475,400	2,814,525	3,232,547	3,338,767	3,827,918	4,081,403	4,411,223	4,754,013
NAT'L INST OF HEALTH	1,766,788	2,020,650	2,313,026	2,624,774	3,018,004	3,118,600	3,575,515	3,795,127	4,063,474	4,346,910
OTHER HHS	133,596	124,044	162,374	189,751	214,543	220,167	252,403	286,276	347,749	407,103
DEPT OF THE INTERIOR .	80,663	76,454	103,033	125,921	138,274	132,986	134,874	126,464	147,268	128,514
DEPT OF TRANSPORTATION	1,210	1,000	900	3,481	1,063	608	174	-	-	-
DEPT OF VETERANS AFFAIRS	15,000	12,900	14,100	15,800	15,400	14,800	17,200	17,300	19,400	15,800
OTHER AGENCIES										
ENVIRON'L PROTECTION AGENCY	10,500	32,687	22,217	29,625	38,634	38,489	31,075	27,196	44,134	76,249
NATIONAL AERONAUTICS & SPACE ADMIN	531,122	535,733	617,033	754,500	750,900	916,700	1,013,717	1,112,713	1,438,387	1,462,086
NAT'L SCI FOUNDATION .	896,569	916,078	999,136	1,132,340	1,261,807	1,275,221	1,371,169	1,433,190	1,553,167	1,754,103
NUCLEAR REGULATORY COMMISSION	-	-	-	-	-	-	-	-	-	-
SMITHSONIAN INST	44,861	52,357	55,960	63,613	71,063	63,273	71,508	75,096	78,967	87,052
ALL OTHER	19,453	18,986	23,592	23,782	21,738	24,747	24,364	22,726	21,845	16,709

SOURCE: NATIONAL SCIENCE FOUNDATION, SRS

TABLE 23. FEDERAL OBLIGATIONS FOR APPLIED RESEARCH BY AGENCY: FISCAL YEARS 1981-90

(THOUSANDS OF DOLLARS)

AGENCY AND SUBDIVISION	1981	1982	1983	1984	1985	1986	1987	1988	ESTIMATES	
									1989	1990
TOTAL, ALL AGENCIES ..	7,171,485	7,540,580	7,993,394	7,911,414	8,314,739	8,349,123	8,997,937	9,176,368	9,951,033	9,890,810
DEPT OF AGRICULTURE ..	426,856	435,708	455,539	442,238	465,552	463,549	473,443	504,618	526,477	501,118
DEPT OF COMMERCE	233,171	259,188	265,620	276,088	300,952	312,936	312,800	311,472	326,252	247,198
DEPT OF DEFENSE, TOTAL	1,996,615	2,266,137	2,437,029	2,200,674	2,306,876	2,303,348	2,439,957	2,362,201	2,527,333	2,411,994
ARMY	388,366	451,561	485,291	486,692	582,631	578,838	692,946	587,990	582,157	590,474
NAVY	460,000	498,400	521,600	449,598	448,222	447,075	432,458	406,043	417,415	411,207
AIR FORCE	491,500	488,100	524,200	547,739	538,355	542,474	563,209	576,677	550,159	581,045
DEFENSE AGENCIES ...	656,749	828,076	905,938	716,645	737,668	734,961	751,344	791,491	977,602	829,268
OTHER DEFENSE	-	-	-	-	-	-	-	-	-	-
DEPT OF EDUCATION	33,212	56,268	61,885	68,680	77,263	91,317	103,827	106,641	115,534	119,307
DEPT OF ENERGY	827,265	1,053,877	1,193,409	1,194,457	1,198,445	1,080,653	1,029,386	1,050,559	1,105,372	999,776
DEPT OF HEALTH & HUMAN SERVICES, TOTAL ..	1,591,857	1,460,890	1,545,446	1,651,498	1,795,787	1,850,791	2,194,026	2,415,560	2,693,774	2,795,672
NAT'L INST OF HEALTH	1,181,521	1,103,802	1,165,179	1,285,643	1,410,113	1,469,000	1,739,142	1,885,571	2,046,126	2,105,790
OTHER HHS	410,336	357,088	380,267	365,855	385,674	381,791	454,884	529,989	647,648	689,882
DEPT OF THE INTERIOR .	289,174	275,006	254,675	254,303	230,978	234,926	247,253	266,016	259,020	237,104
DEPT OF TRANSPORTATION	87,379	65,685	71,696	74,211	70,163	67,615	68,423	91,045	108,814	105,720
DEPT OF VETERANS AFFAIRS	112,700	110,100	132,000	156,100	193,700	155,100	173,100	178,800	197,700	169,300
OTHER AGENCIES										
ENVIRON'L PROTECTION AGENCY	207,800	210,692	152,380	142,336	175,994	179,292	246,126	240,723	259,286	262,182
NATIONAL AERONAUTICS & SPACE ADMIN	876,036	871,407	927,787	954,700	1,032,700	1,152,300	1,255,530	1,218,862	1,426,093	1,584,201
NAT'L SCI FOUNDATION .	58,895	57,087	62,854	70,480	83,776	78,114	99,336	99,583	110,441	126,892
NUCLEAR REGULATORY COMMISSION	219,667	220,287	207,295	190,675	149,959	123,785	122,468	108,480	115,884	129,966
SMITHSONIAN INST	-	-	-	-	-	-	-	-	-	-
ALL OTHER	210,858	198,248	225,779	234,974	232,594	255,397	232,262	221,808	179,053	200,380

SOURCE: NATIONAL SCIENCE FOUNDATION, SRS

TABLE 24. FEDERAL OBLIGATIONS FOR DEVELOPMENT BY AGENCY: FISCAL YEARS 1981-90

(THOUSANDS OF DOLLARS)

AGENCY AND SUBDIVISION	1981	1982	1983	1984	1985	1986	1987	1988	ESTIMATES	
									1989	1990
TOTAL, ALL AGENCIES ..	20,891,144	23,410,404	24,458,012	27,246,092	32,226,144	34,910,165	37,312,696	38,285,087	41,486,573	44,992,641
DEPT OF AGRICULTURE ..	32,974	30,811	30,047	31,284	32,039	32,122	28,951	31,421	31,360	32,138
DEPT OF COMMERCE	78,550	60,223	50,151	61,525	74,580	59,707	63,661	46,619	47,229	31,889
DEPT OF DEFENSE, TOTAL	13,907,749	17,669,753	19,770,140	22,324,339	26,623,221	29,710,676	31,883,976	32,176,017	34,194,791	36,865,845
ARMY	2,707,704	3,121,266	3,304,474	3,516,750	3,747,409	3,982,082	4,109,561	4,052,328	4,593,934	5,045,259
NAVY	4,307,952	5,066,356	5,241,206	6,840,227	8,336,100	8,865,947	8,721,073	8,766,212	8,856,137	9,571,086
AIR FORCE	6,351,947	8,723,958	10,124,216	11,351,547	12,524,264	12,834,833	14,562,891	14,260,532	14,528,248	14,271,880
DEFENSE AGENCIES ...	499,095	717,136	1,038,662	557,252	1,964,810	3,910,712	4,353,538	4,868,436	6,009,665	7,558,038
OTHER DEFENSE	41,051	41,037	61,582	58,563	50,638	117,102	136,913	228,509	206,807	419,582
DEPT OF EDUCATION	51,074	57,514	35,614	34,801	32,961	25,469	25,570	29,688	41,151	20,127
DEPT OF ENERGY	3,504,620	3,012,070	2,575,555	2,648,689	2,824,971	2,647,983	2,659,351	2,801,033	3,059,610	2,888,039
DEPT OF HEALTH & HUMAN SERVICES, TOTAL ..	434,900	335,161	331,684	364,670	422,702	468,046	584,345	661,078	782,998	826,223
NAT'L INST OF HEALTH	384,940	308,696	311,017	347,019	399,620	417,500	536,200	610,200	682,100	724,500
OTHER HHS	49,960	26,465	20,667	17,651	23,082	50,546	48,145	50,878	100,898	101,723
DEPT OF THE INTERIOR .	57,268	29,614	24,765	30,653	22,433	17,307	21,707	24,288	26,014	21,944
DEPT OF TRANSPORTATION	326,950	243,398	275,132	370,643	357,633	317,251	255,748	212,909	226,171	224,414
DEPT OF VETERANS AFFAIRS	16,700	14,300	15,300	18,400	17,500	16,300	19,200	19,200	18,500	18,300
OTHER AGENCIES										
ENVIRON'L PROTECTION AGENCY	107,400	91,710	66,112	89,211	105,785	99,538	71,043	79,511	82,493	82,296
NATIONAL AERONAUTICS & SPACE ADMIN	2,185,997	1,670,719	1,116,759	1,112,700	1,543,600	1,350,800	1,517,825	1,998,783	2,823,878	3,824,077
NAT'L SCI FOUNDATION .	6,100	2,162	-	-	-	-	-	-	-	-
NUCLEAR REGULATORY COMMISSION	-	-	-	-	-	-	-	-	-	-
SMITHSONIAN INST	-	-	-	-	-	-	-	-	-	-
ALL OTHER	180,862	192,969	166,753	159,177	168,719	164,966	181,319	204,540	152,378	157,349

SOURCE: NATIONAL SCIENCE FOUNDATION, SRS

Table B-25. Companies' own and Federal funds for industrial R&D performance by industry and size of company in selected years

[Dollars in millions]

Industry and size of company	SIC code	1980	1982	1984	1985	1986	1987	1988
Total...................................	....	$44,505	$58,650	$74,800	$84,239	$88,179	$94,117	$99,422
Distribution by industry								
Food, kindred, and tobacco products(1)........	20,21	620	(D)	(D)	(D)	(D)	1,223	(D)
Textiles and apparel..........................	22,23	115	(D)	(D)	(D)	(D)	(D)	(D)
Lumber, wood products, and furniture..........	24,25	148	159	143	147	144	140	(D)
Paper and allied products.....................	26	495	566	(D)	(D)	(D)	(D)	(D)
Chemicals and allied products.................	28	4,636	6,604	7,927	8,540	8,843	9,878	10,774
Industrial chemicals.........................	281-82,286	2,197	3,206	3,240	3,498	3,552	3,901	3,959
Drugs and medicines..........................	283	1,777	(D)	(D)	(D)	3,658	(D)	4,737
Other chemicals..............................	284-85,287-89	662	(D)	(D)	(D)	1,633	(D)	2,078
Petroleum refining and extraction.............	13,29	1,552	(D)	(D)	(D)	(D)	1,897	1,958
Rubber products...............................	30	656	(D)	(D)	(D)	(D)	(D)	(D)
Stone, clay, and glass products...............	32	406	(D)	(D)	(D)	950	998	(D)
Primary metals................................	33	728	987	(D)	(D)	(D)	744	663
Ferrous metals and products.................	331-32,3398-99	443	(D)	(D)	(D)	(D)	(D)	260
Nonferrous metals and products..............	333-36	285	(D)	336	416	458	(D)	403
Fabricated metal products.....................	34	550	625	842	829	895	949	951
Machinery.....................................	35	5,901	8,078	10,504	12,216	(D)	(D)	(D)
Office, computing, and accounting machines..	357	3,962	(D)	(D)	(D)	(D)	(D)	(D)
Other machinery, except electrical..........	351-56,358-59	1,939	(D)	(D)	(D)	2,396	2,605	2,766
Electrical equipment..........................	36	9,175	10,923	13,778	14,432	14,980	16,053	16,744
Radio and TV receiving equipment............	365	556	(D)	(D)	(D)	133	143	138
Communication equipment.....................	366	4,024	5,839	8,685	9,397	9,669	10,311	10,387
Electronic components.......................	367	1,547	1,740	2,831	3,385	(D)	4,342	5,039
Other electrical equipment..................	361-64,369	3,048	(D)	(D)	(D)	(D)	1,257	1,180
Transportation equipment......................	37	14,315	(D)	(D)	(D)	31,275	34,377	36,224
Motor vehicles and motor vehicles equipment.	371	4,955	4,797	6,057	6,984	(D)	(D)	(D)
Other transportation equipment..............	373-75,379	162	(D)	(D)	(D)	(D)	(D)	(D)
Aircraft and missiles.......................	372,376	9,198	14,451	18,858	22,231	21,050	24,488	25,667
Professional and scientific instruments.......	38	3,029	3,930	4,602	5,013	5,103	5,264	5,561
Scientific and mechanical measuring instruments................................	381-82	1,352	(D)	(D)	(D)	(D)	(D)	(D)
Optical, surgical, photographic, and other instruments................................	383-87	1,677	(D)	(D)	(D)	(D)	(D)	(D)
Other manufacturing industries................	27,31,39	364	(D)	(D)	(D)	382	(D)	(D)
Nonmanufacturing industries...................	08,10-12,14-17, 40-67,72-73, 806-07,891	1,815	2,472	4,905	6,714	7,446	8,690	8,718
Distribution by size of company [Based on number of employees]								
Less than 500..		2,065	2,934	4,402	5,866	7,071	7,603	(S)
500 to 999...				1,439	1,648	1,902	1,911	1,740
1,000 to 4,999...		2,701	3,864	5,520	6,240	7,472	8,129	8,391
5,000 to 9,999...		2,028	2,751	3,251	4,022	4,251	4,488	5,571
10,000 to 24,999...		6,017	7,943	11,351	11,109	10,493	12,480	11,564
25,000 or more...		31,693	41,156	48,837	55,354	56,991	59,506	64,704

(D) Data have been withheld to avoid disclosing operations of individual companies.
(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."

SOURCE: National Science Foundation, SRS

Table B-26. Companies' own funds for industrial R&D performance by industry and size of company in selected years
[Dollars in millions]

Industry and size of company	SIC code	1980	1982	1984	1985	1986	1987	1988
Total		$30,476	$40,105	$51,404	$57,043	$59,932	$62,806	$66,463
Distribution by industry								
Food, kindred, and tobacco products(1)	20,21	(D)	777	1,081	1,136	1,280	1,221	1,274
Textiles and apparel	22,23	(D)	136	182	218	246	231	183
Lumber, wood products, and furniture	24,25	148	159	143	147	144	140	155
Paper and allied products	26	495	566	594	576	538	603	657
Chemicals and allied products	28	4,264	6,197	7,736	8,310	8,664	9,685	10,580
Industrial chemicals	281-82,286	1,856	2,810	3,057	3,281	3,374	3,714	3,767
Drugs and medicines	283	1,756	2,473	3,310	3,481	3,657	4,139	4,735
Other chemicals	284-85,287-89	653	914	1,369	1,548	1,633	1,832	2,078
Petroleum refining and extraction	13,29	1,401	2,003	2,245	2,194	1,971	1,883	1,937
Rubber products	30	(D)	617	671	659	655	635	651
Stone, clay, and glass products	32	363	472	705	825	941	988	945
Primary metals	33	594	711	683	730	786	725	643
Ferrous metals and products	331-32,3398-99	338	426	357	323	336	257	260
Nonferrous metals and products	333-36	256	285	326	407	450	468	383
Fabricated metal products	34	501	565	773	780	800	799	808
Machinery	35	5,254	7,227	9,312	10,721	10,701	10,819	12,132
Office, computing, and accounting machines	357	3,436	4,944	7,011	8,418	8,380	8,260	9,412
Other machinery, except electrical	351-56,358-59	1,818	2,283	2,301	2,303	2,321	2,559	2,720
Electrical equipment	36	5,431	6,682	9,037	9,271	9,767	10,602	11,193
Radio and TV receiving equipment	365	346	364	362	350	133	143	138
Communication equipment	366	2,367	3,555	5,147	5,174	5,117	5,533	5,768
Electronic components	367	1,165	1,342	2,354	2,826	3,357	3,685	4,120
Other electrical equipment	361-64,369	1,553	1,421	1,174	921	1,160	1,241	1,167
Transportation equipment	37	6,958	8,621	10,406	12,092	13,567	13,593	14,009
Motor vehicles and motor vehicles equipment	371	4,300	4,321	5,384	6,164	7,171	7,267	7,769
Other transportation equipment	373-75,379	88	114	258	279	330	357	388
Aircraft and missiles	372,376	2,570	4,186	4,764	5,649	6,066	5,969	5,852
Professional and scientific instruments	38	2,456	3,407	4,211	4,622	4,752	4,991	5,346
Scientific and mechanical measuring instruments	381-82	1,001	1,363	1,671	1,596	1,521	1,634	1,672
Optical, surgical, photographic, and other instruments	383-87	1,454	2,044	2,540	3,026	3,231	3,357	3,674
Other manufacturing industries	27,31,39	339	493	373	361	380	394	377
Nonmanufacturing industries	08,10-12,14-17, 40-67,72-73, 806-07,891	1,037	1,472	3,252	4,401	4,740	5,496	5,575
Distribution by size of company [Based on number of employees]								
Less than 500		1,711	2,411	3,781	5,127	6,203	6,583	(S)
500 to 999				1,341	1,531	1,765	1,750	1,613
1,000 to 4,999		2,257	3,241	4,618	5,249	6,243	6,701	6,868
5,000 to 9,999		1,596	2,224	2,764	3,350	3,455	3,750	4,614
10,000 to 24,999		4,867	6,448	8,546	8,366	8,489	10,102	9,717
25,000 or more		20,045	25,781	30,354	33,421	33,778	33,920	37,126

Note: Company funds include all funds for industrial R&D work performed within company facilities from all sources (e.g. outside organizations such as research institutions, universities and colleges, other nonprofit organizations, and State governments, as well as companies' own funds) except funds provided by the Federal Government.
Company-financed research and development contracted to outside organizations (except other companies) is excluded.

(D) Data have been withheld to avoid disclosing operations of individual companies.
(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."

SOURCE: National Science Foundation, SRS

Table B-27. Federal funds for industrial R&D performance by industry and size of company in selected years

[Dollars in millions]

Industry and size of company	SIC code	1980	1982	1984	1985	1986	1987	1988
Total		$14,029	$18,545	$23,396	$27,196	$28,247	$31,311	$32,959
Distribution by industry								
Food, kindred, and tobacco products(1)	20,21	(D)	(D)	(D)	(D)	(D)	2	(D)
Textiles and apparel	22,23	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Lumber, wood products, and furniture	24,25	(D)	0	0	0	0	0	(D)
Paper and allied products	26	(D)	0	(D)	(D)	(D)	(D)	(D)
Chemicals and allied products	28	372	407	191	230	179	192	195
Industrial chemicals	281-82,286	341	396	183	217	178	187	192
Drugs and medicines	283	(D)	(D)	(D)	(D)	1	(D)	3
Other chemicals	284-85,287-89	(D)	(D)	(D)	(D)	0	(D)	0
Petroleum refining and extraction	13,29	151	(D)	(D)	(D)	(D)	14	21
Rubber products	30	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Stone, clay, and glass products	32	(D)	(D)	(D)	(D)	9	10	(D)
Primary metals	33	135	276	(D)	(D)	(D)	19	21
Ferrous metals and products	331-32,3398-99	105	(D)	(D)	(D)	(D)	(D)	1
Nonferrous metals and products	333-36	30	(D)	10	9	8	(D)	20
Fabricated metal products	34	49	60	69	49	95	150	142
Machinery	35	647	851	1,192	1,495	(D)	(D)	(D)
Office, computing, and accounting machines	357	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other machinery, except electrical	351-56,358-59	(D)	(D)	(D)	(D)	75	46	46
Electrical equipment	36	3,744	4,241	4,741	5,161	5,213	5,452	5,551
Radio and TV receiving equipment	365	210	(D)	(D)	(D)	0	0	0
Communication equipment	366	1,657	2,284	3,538	4,223	4,552	4,778	4,619
Electronic components	367	382	398	477	559	(D)	657	919
Other electrical equipment	361-64,369	1,495	(D)	(D)	(D)	(D)	17	13
Transportation equipment	37	(D)	(D)	(D)	(D)	17,708	20,784	22,215
Motor vehicles and motor vehicles equipment	371	655	476	673	820	(D)	(D)	(D)
Other transportation equipment	373-75,379	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Aircraft and missiles	372,376	6,628	10,265	14,094	16,582	14,984	18,519	19,815
Professional and scientific instruments	38	573	523	391	391	351	273	215
Scientific and mechanical measuring instruments	381-82	350	(D)	(D)	(D)	(D)	(D)	(D)
Optical, surgical, photographic, and other instruments	383-87	223	(D)	(D)	(D)	(D)	(D)	(D)
Other manufacturing industries	27,31,39	25	(D)	(D)	(D)	2	(D)	(D)
Nonmanufacturing industries	08,10-12,14-17, 40-67,72-73, 806-07,891	779	1,000	1,653	2,313	2,706	3,194	3,143
Distribution by size of company [Based on number of employees]								
Less than 500		354	523	621	739	868	1,020	927
500 to 999				98	117	137	161	127
1,000 to 4,999		444	623	902	991	1,229	1,428	1,523
5,000 to 9,999		432	527	487	672	796	738	957
10,000 to 24,999		1,150	1,495	2,805	2,743	2,004	2,378	1,847
25,000 or more		11,648	15,377	18,483	21,933	23,213	25,586	27,578

(D) Data have been withheld to avoid disclosing operations of individual companies.
(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."

SOURCE: National Science Foundation, SRS

Table B-28. Companies' own and Federal R&D funds as a percent of net sales in R&D-performing manufacturing companies by industry and size of company in selected years

[Percent]

Industry and size of company	SIC code	1978	1980	1982	1983	1984	1985	1986	1987	1988
Total		2.9	3.0	3.8	3.9	3.9	4.4	4.7	4.6	4.8
Distribution by industry										
Food, kindred, and tobacco products(1)	20,21	0.4	0.4	(D)	(D)	(D)	(D)	(D)	0.6	(D)
Textiles and apparel	22,23	0.4	0.4	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Lumber, wood products, and furniture	24,25	0.7	0.8	0.8	0.8	0.7	0.8	0.6	0.6	(D)
Paper and allied products	26	0.9	1.0	1.1	(D)	(D)	(D)	(D)	(D)	(D)
Chemicals and allied products	28	3.6	3.6	4.3	4.4	4.7	5.0	5.2	5.3	5.4
Industrial chemicals	281-82,286	3.5	3.3	4.0	3.9	4.0	4.4	4.6	4.7	4.5
Drugs and medicines	283	6.2	6.2	(D)	(D)	(D)	(D)	8.5	(D)	9.0
Other chemicals	284-85,287-89	1.8	1.9	(D)	(D)	(D)	(D)	3.3	(D)	3.5
Petroleum refining and extraction	13,29	0.7	0.6	(D)	(D)	(D)	(D)	(D)	1.0	1.1
Rubber products	30	1.9	2.2	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Stone, clay, and glass products	32	1.3	1.4	(D)	(D)	(D)	(D)	2.5	2.6	(D)
Primary metals	33	0.7	0.7	1.1	1.3	(D)	(D)	(D)	0.9	0.8
Ferrous metals and products	331-32,3398-99	0.6	0.7	(D)	(D)	(D)	(D)	(D)	(D)	0.6
Nonferrous metals and products	333-36	0.8	0.7	(D)	(D)	1.2	1.4	1.5	(D)	1.2
Fabricated metal products	34	1.1	1.4	1.3	1.4	1.5	1.5	1.5	1.5	1.6
Machinery	35	4.6	5.0	5.6	6.2	6.4	7.6	(D)	(D)	(D)
Office, computing, and accounting machines	357	11.1	12.0	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other machinery, except electrical	351-56,358-59	2.1	2.3	(D)	(D)	(D)	(D)	3.0	3.0	3.0
Electrical equipment	36	5.8	6.6	7.2	7.9	6.8	7.6	7.9	8.2	8.1
Radio and TV receiving equipment	365	1.8	4.3	(D)	(D)	(D)	(D)	3.6	3.2	3.1
Communication equipment	366	7.7	9.1	11.0	11.5	9.8	10.1	9.9	10.2	9.9
Electronic components	367	6.7	7.9	6.8	7.7	7.8	9.6	(D)	10.0	10.2
Other electrical equipment	361-64,369	5.1	4.9	(D)	(D)	(D)	(D)	(D)	2.7	2.5
Transportation equipment	37					(D)	(D)	8.3	8.7	8.9
Motor vehicles and motor vehicles equipment	371	3.3	4.9	4.5	4.0	3.4	3.8	(D)	(D)	(D)
Other transportation equipment	373-75,379	0.8	0.6	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Aircraft and missiles	372,376	13.3	13.7	17.1	15.2	15.4	14.9	13.4	14.7	15.4
Professional and scientific instruments	38	6.9	7.5	8.4	8.6	8.3	8.9	8.8	7.9	7.7
Scientific and mechanical measuring instruments	381-82	7.1	8.4	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Optical, surgical, photographic, and other instruments	383-87	6.8	6.9	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other manufacturing industries	27,31,39	0.5	0.4	(D)	(D)	(D)	(D)	1.2	(D)	(D)
Distribution by size of company [Based on number of employees]										
Less than 500		1.6	1.4	1.8	2.5	2.9	3.6	4.1	3.9	3.8
500 to 999						2.3	2.4	2.4	2.3	2.2
1,000 to 4,999		1.6	1.8	1.9	2.0	2.2	2.6	2.5	2.6	2.5
5,000 to 9,999		1.4	1.4	1.7	1.7	1.8	1.9	2.3	2.3	2.7
10,000 to 24,999		1.9	1.7	2.4	2.8	3.1	3.1	3.2	3.1	3.1
25,000 or more		4.0	4.0	5.4	5.5	5.3	6.2	6.5	6.6	6.8

(D) Data have been withheld to avoid disclosing operations of individual companies.

(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."

SOURCE: National Science Foundation, SRS

Table B-29. Companies' own R&D funds as a percent of net sales in R&D-performing manufacturing companies by industry and size of company in selected years

[Percent]

Industry and size of company	SIC code	1978	1980	1982	1983	1984	1985	1986	1987	1988
Total	....	2.0	2.1	2.6	2.6	2.6	3.0	3.2	3.1	3.2
Distribution by industry										
Food, kindred, and tobacco products(1)	20,21	(D)	(D)	0.4	0.4	0.4	0.6	0.6	0.6	0.5
Textiles and apparel	22,23	(D)	(D)	0.5	0.4	0.5	0.5	0.5	0.4	0.3
Lumber, wood products, and furniture	24,25	0.7	0.8	0.8	0.8	0.7	0.8	0.6	0.6	0.6
Paper and allied products	26	(D)	1.0	1.1	0.9	0.8	0.8	0.7	0.6	0.8
Chemicals and allied products	28	3.2	3.3	4.0	4.2	4.6	4.9	5.1	5.2	5.3
Industrial chemicals	281-82,286	2.9	2.8	3.5	3.4	3.8	4.2	4.4	4.4	4.3
Drugs and medicines	283	(D)	6.1	7.0	7.7	8.2	8.0	8.4	8.7	9.0
Other chemicals	284-85,287-89	(D)	1.9	2.3	2.5	2.9	3.1	3.3	3.3	3.5
Petroleum refining and extraction	13,29	0.7	0.5	0.8	0.7	0.7	0.9	1.1	1.0	1.1
Rubber products	30	(D)	(D)	1.7	1.7	1.9	1.8	1.7	1.6	1.6
Stone, clay, and glass products	32	(D)	1.3	1.7	1.9	1.9	2.3	2.4	2.5	2.6
Primary metals	33	0.6	0.5	0.8	0.8	0.9	0.9	1.0	0.9	0.8
Ferrous metals and products	331-32,3398-99	0.5	0.5	0.6	0.6	0.6	0.5	0.7	0.6	0.6
Nonferrous metals and products	333-36	0.8	0.6	1.3	1.2	1.2	1.4	1.5	1.3	1.1
Fabricated metal products	34	1.0	1.2	1.2	1.3	1.4	1.4	1.4	1.2	1.3
Machinery	35	4.2	4.5	5.0	5.4	5.8	6.7	7.3	7.1	7.5
Office, computing, and accounting machines	357	9.8	10.4	10.4	10.0	10.5	12.4	12.4	12.3	13.4
Other machinery, except electrical	351-56,358-59	2.0	2.2	2.4	2.4	2.5	2.6	2.9	3.0	3.0
Electrical equipment	36	3.4	3.9	4.4	5.0	4.5	4.8	5.1	5.4	5.4
Radio and TV receiving equipment	365	1.4	2.7	3.3	2.9	3.7	4.3	3.6	3.2	3.1
Communication equipment	366	4.5	5.4	6.7	7.2	5.1	5.4	5.2	5.5	5.5
Electronic components	367	(D)	5.9	5.2	6.6	6.6	8.2	9.2	8.5	8.3
Other electrical equipment	361-64,369	(D)	2.5	2.3	2.6	2.2	2.0	2.2	2.6	2.5
Transportation equipment	37					3.3	3.4	3.6	3.4	3.4
Motor vehicles and motor vehicles equipment	371	2.9	4.2	4.0	3.5	3.0	3.1	3.3	3.4	3.4
Other transportation equipment	373-75,379	(D)	0.3	0.7	1.7	2.0	2.3	2.7	2.5	2.6
Aircraft and missiles	372,376	3.2	3.8	5.1	4.1	4.0	3.9	4.0	3.6	3.5
Professional and scientific instruments	38	5.7	6.1	7.3	7.7	7.6	8.3	8.2	7.5	7.4
Scientific and mechanical measuring instruments	381-82	5.9	6.2	7.6	8.8	8.3	8.4	8.4	8.1	8.2
Optical, surgical, photographic, and other instruments	383-87	5.6	6.0	7.1	7.1	7.3	8.1	8.0	7.2	7.1
Other manufacturing industries	27,31,39	0.5	0.4	0.8	1.0	1.1	1.0	1.2	1.1	1.1
Distribution by size of company [Based on number of employees]										
Less than 500		1.4	1.2	1.6	2.2	2.8	3.4	4.0	3.8	3.7
500 to 999						2.2	2.2	2.2	2.2	2.1
1,000 to 4,999		1.4	1.4	1.7	2.0	2.0	2.4	2.4	2.4	2.3
5,000 to 9,999		1.2	1.1	1.5	1.3	1.6	1.8	2.0	2.0	2.4
10,000 to 24,999		1.4	1.4	2.0	2.3	2.5	2.5	2.6	2.5	2.6
25,000 or more		2.5	2.5	3.3	3.4	3.2	3.5	3.7	3.8	3.9

(D) Data have been withheld to avoid disclosing operations of individual companies.
(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."

SOURCE: National Science Foundation, SRS

Table B-30. Funds for industrial applied R&D performance by product field and source of funds: 1987

[Dollars in millions]

Product field	SIC Code	Total	Federal	Company
Total		$47,144	$18,858	$28,286
Food and kindred products	20	464	0	464
Textile mill products	22	72	(D)	(D)
Chemicals, except drugs and medicines	28, except 283	4,354	53	4,301
Industrial inorganic and organic chemicals	281,286	458	(D)	(D)
Plastics materials and synthetic resins, rubber, and fibers	282	983	13	970
Drugs and medicines	283	1,913	(D)	(D)
Agricultural chemicals	287	398	0	398
Other chemicals	284-85,289	602	(D)	(D)
Petroleum refining	29	583	(D)	(D)
Rubber and miscellaneous plastics products	30	219	(D)	(D)
Stone, clay, and glass products	32	175	9	166
Primary metals	33	223	46	177
Ferrous metals and products	331-32,3398-99	126	37	89
Nonferrous metals and products	333-36	97	9	88
Fabricated metal products	34	1,164	770	394
Ordnance and accessories, n.e.c	348	208	160	48
Other fabricated metal products	341-47,349	956	610	346
Machinery	35	6,191	367	5,824
Engines and turbines	351	625	(D)	(D)
Farm machinery and equipment	352	198	0	198
Construction, mining, and materials handling machinery	353	324	(D)	(D)
Metalworking machinery and equipment	354	146	(D)	(D)
Office, computing, and accounting machines	357	4,573	(D)	(D)
Other machinery, except electrical	355-56,358-59	325	(D)	(D)
Electrical equipment	36	9,770	3,822	5,947
Electric transmission and distribution equipment	361,3825	(D)	(D)	72
Electrical industrial apparatus	362	149	41	108
Radio and TV receiving equipment	365	(D)	(D)	58
Communication equipment	366	4,771	1,618	3,153
Electronic components	367	3,747	1,894	1,853
Other electrical equipment and supplies	363-64,368-69	752	49	703
Transportation equipment	37	16,491	(D)	(D)
Motor vehicles and equipment	371	4,009	60	3,949
Other transportation equipment	373-75,379	137	(D)	(D)
Aircraft and parts	372	7,513	4,956	2,557
Guided missiles and spacecraft	376	4,832	4,386	446
Professional and scientific instruments	38, except 3825	959	113	846
Scientific and mechanical measuring instruments	381-82	609	88	521
Optical, surgical, photographic, and other instruments	383-87	350	25	325
Other product fields, n.e.c		6,480	4,201	2,283

n.e.c. Not elsewhere classified.

(D) Data have been withheld to avoid disclosing operations of individual companies.

NOTE: This table contains only data reported by survey respondents. Imputation of R&D expenditures by product field was eliminated beginning in 1985. Product field data were not collected in the 1988 survey.

SOURCE: National Science Foundation, SRS

Table B-31. Full-time-equivalent number of R&D scientists and engineers by industry and size of company in selected years

[In thousands]

Industry and size of company	SIC code	1980	1982	1984	1985	1986	1987	1988	1989
Total (January)		450.6	509.8	584.1	622.5	671.0	697.3	708.6	724.9
Total (Annual Average)		469.2	525.4	603.3	646.8	684.2	703.0	716.8	N/A
Distribution by industry									
Food, kindred, and tobacco products(1)	20,21	7.2	7.4	7.4	(S)	(S)	(S)	(S)	(S)
Textiles and apparel	22,23	(2)	1.9	2.3	2.8	2.6	2.5	2.4	(S)
Lumber, wood products, and furniture	24,25	1.7	(2)	(2)	(S)	(S)	(S)	1.3	(S)
Paper and allied products	26	7.4	8.4	6.6	6.6	6.4	5.8	6.1	(S)
Chemicals and allied products	28	51.4	61.6	69.8	71.1	75.8	73.0	75.8	77.4
Industrial chemicals	281-82,286	20.9	25.9	25.6	23.5	24.9	24.4	(S)	(S)
Drugs and medicines	283	21.6	25.6	(2)	30.8	31.8	29.1	33.0	33.9
Other chemicals	284-85,287-89	8.9	10.1	13.4	16.7	19.1	19.5	20.3	(S)
Petroleum refining and extraction	13,29	10.8	15.6	13.3	13.5	10.4	8.6	9.5	10.0
Rubber products	30	(1)	8.1	(2)	(S)	(S)	(S)	(S)	(S)
Stone, clay, and glass products	32	5.4	5.1	5.6	6.6	7.5	8.6	8.6	8.3
Primary metals	33	8.1	8.4	8.4	7.1	5.7	6.0	5.6	5.6
Ferrous metals and products	331-32,3398-99	4.7	5.2	5.3	4.2	2.5	2.6	2.3	(S)
Nonferrous metals and products	333-36	3.4	3.2	3.1	2.9	3.2	3.4	3.3	3.4
Fabricated metal products	34	7.8	8.2	16.6	(S)	(S)	(S)	10.5	(S)
Machinery	35	62.1	76.0	87.0	81.7	89.7	96.4	98.4	99.7
Office, computing, and accounting machines	357	41.8	48.1	56.5	61.8	71.9	73.8	74.4	76.4
Other machinery, except electrical	351-56,358-59	20.3	27.9	30.5	19.9	17.8	22.6	24.0	23.3
Electrical equipment	36	94.5	109.8	113.2	113.2	117.9	128.3	132.5	139.9
Radio and TV receiving equipment	365	4.0	7.8	(2)	(S)	1.8	1.4	1.3	1.3
Communication equipment	366	42.4	45.9	59.3	62.2	65.0	73.3	73.1	75.5
Electronic components	367	18.1	24.4	(2)	29.2	(S)	40.2	44.3	(S)
Other electrical equipment	361-64,369	30.0	31.7	18.4	17.9	16.5	13.5	(S)	(S)
Transportation equipment	37	125.6	122.3	(2)	160.3	179.2	184.8	188.2	192.8
Motor vehicles and motor vehicles equipment	371	38.2	30.0	28.6	28.7	33.9	50.2	47.3	45.9
Other transportation equipment	373-75,379	1.5	1.2	(2)	(S)	(S)	(S)	(S)	(S)
Aircraft and missiles	372,376	85.9	91.1	111.5	130.2	144.8	130.1	136.4	142.1
Professional and scientific instruments	38	32.8	42.7	(2)	(S)	(S)	(S)	(S)	(S)
Scientific and mechanical measuring instruments	381-82	(2)	(2)	(2)	(S)	(S)	(S)	(S)	(S)
Optical, surgical, photographic, and other instruments	383-87	16.3	16.1	(2)	19.8	24.0	26.2	24.9	(S)
Other manufacturing industries	27,31,39	4.6	5.5	(2)	(S)	(S)	(S)	6.4	(S)
Nonmanufacturing industries	08,10-12,14-17, 40-67,72-73, 806-07,891	19.8	27.1	49.8	66.8	75.1	88.6	101.9	(S)
Distribution by size of company [Based on number of employees]									
Less than 500		34.4	40.7	81.9	78.3	(S)	105.9	109.0	(S)
500 to 999					16.5	(S)	21.6	19.3	18.0
1,000 to 4,999		34.8	42.8	52.6	61.6	66.7	73.7	81.9	80.3
5,000 to 9,999		29.6	36.6	30.1	28.5	38.9	39.5	40.2	47.5
10,000 to 24,999		64.4	77.0	84.0	89.9	88.4	83.2	94.5	86.1
25,000 or more		287.4	312.7	335.5	347.6	365.3	373.4	365.2	380.1

(S) Data have been withheld due to imputation of 50 percent or more.
(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."
(2) Not separately available but included in total.

N/A Not available

SOURCE: National Science Foundation, SRS

Table B-32. R&D scientists and engineers per 1,000 employees in R&D performing manufacturing companies by industry and size of company in selected years

Industry and size of company	SIC code	1978	1980	1982	1983	1984	1985	1986	1987	1988
Distribution by industry										
Total	....	27	27	33	34	40	43	45	45	47
Food, kindred,and tobacco products(1)	20,21	7	5	6	6	7	8	7	7	7
Textiles and apparel	22,23	3	3	4	4	5	5	4	4	4
Lumber, wood products, and furniture	24,25	7	6	(S)	(S)	6	6	5	5	5
Paper and allied products	26	14	14	14	12	13	13	11	11	11
Chemicals and allied products	28	43	42	51	54	57	57	70	68	72
Industrial chemicals	281-82,286	38	36	44	45	41	39	56	52	54
Drugs and medicines	283	65	60	74	(S)	89	81	98	98	108
Other chemicals	284-85,287-89	27	30	37	39	51	62	63	61	61
Petroleum refining and extraction	13,29	19	17	22	22	22	21	19	20	24
Rubber products	30	18	(S)	(S)	(S)	27	26	25	19	17
Stone, clay, and glass products	32	13	13	15	16	17	20	20	24	27
Primary metals	33	8	7	10	11	12	12	11	12	13
Ferrous metals and products	331-32,3398-99	6	6	8	11	11	11	7	9	9
Nonferrous metals and products	333-36	12	12	13	13	16	16	17	16	18
Fabricated metal products	34	12	14	(S)	(S)	(S)	(S)	(S)	17	18
Machinery	35	39	36	48	57	56	60	64	67	68
Office, computing, and accounting machines	357	79	72	80	88	90	99	107	115	116
Other machinery, except electrical	351-56,358-59	19	18	26	30	32	29	26	29	30
Electrical equipment	36	41	44	55	51	49	53	59	65	69
Radio and TV receiving equipment	365	22	35	(S)	(S)	(S)	23	55	45	49
Communication equipment	366	48	55	74	61	56	62	68	73	76
Electronic components	367	51	55	66	(S)	(S)	81	82	86	98
Other electrical equipment	361-64,369	32	32	(S)	(S)	30	30	26	28	29
Transportation equipment	37					(S)	71	69	68	74
Motor vehicles and motor vehicles equipment	371	26	30	31	30	27	28	38	42	43
Other transportation equipment	373-75,379	13	9	12	(S)	(S)	8	23	38	39
Aircraft and missiles	372,376	96	92	94	102	110	116	99	91	101
Professional and scientific instruments	38	42	39	(S)	(S)	(S)	(S)	(S)	71	71
Scientific and mechanical measuring instruments	381-82	50	(S)	(S)	(S)	(S)	(S)	(S)	85	90
Optical, surgical, photographic, and other instruments	383-87	44	48	(S)	(S)	(S)	70	61	63	60
Other manufacturing industries	27,31,39	9	7	9	(S)	(S)	(S)	(S)	18	18
Distribution by size of company [Based on number of employees]										
Less than 500		25	25	30	34	42	50	59	59	56
500 to 999						21	21	23	27	29
1,000 to 4,999		18	19	22	25	24	26	32	30	32
5,000 to 9,999		17	19	23	22	19	19	28	29	32
10,000 to 24,999		20	20	26	26	29	30	33	32	35
25,000 or more		34	34	43	42	47	49	56	57	60

Notes: The number of R&D scientists and engineers for 1988 is derived by dividing the arithmetic mean of scientists and engineers employed in January 1988 and in January 1989 by the number of employees in all activities in March 1988.

Nonmanufacturing industries are included in the 1978-83 calculations.

(S) Data have been withheld due to imputation of 50 percent or more.
(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."

SOURCE: National Science Foundation, SRS

Table B-33.-- R&D expenditures at universities and colleges by source of funds, character of work, and science/engineering field: fiscal years 1981-88

(dollars in thousands)

Source, character, and field	1981	1982	1983	1984	1985	1986	1987	1988
Total	6,829,417	7,306,361	7,864,458	8,594,463	9,663,298	10,903,534	12,079,814	13,422,137
Source of funds:								
Federal Government	4,560,568	4,758,632	4,979,611	5,416,677	6,055,820	6,701,503	7,328,388	8,164,801
State and local governments	546,248	613,997	622,552	686,280	747,842	913,327	1,020,153	1,122,601
Industry	293,816	339,177	388,516	474,310	560,557	716,853	807,141	892,424
Institutional funds	994,613	1,105,590	1,296,837	1,405,520	1,608,744	1,858,479	2,114,193	2,314,074
All other sources	434,172	488,965	576,942	611,676	690,335	713,372	809,939	928,237
Character of work:								
Basic research	4,577,647	4,863,909	5,288,233	5,708,658	6,539,308	7,476,451	8,342,584	8,869,750
Applied research and development	2,251,770	2,442,452	2,576,225	2,885,805	3,123,990	3,427,083	3,737,230	4,552,387
Field:								
Engineering, total	967,944	1,033,515	1,123,944	1,219,312	1,413,566	1,636,088	1,884,708	2,083,745
Aeronautical and astronautical	52,152	60,077	65,539	66,773	86,092	100,006	117,142	123,379
Chemical	76,397	83,153	90,773	95,162	109,057	124,963	140,236	154,392
Civil	107,317	114,537	124,935	137,485	151,576	175,334	187,945	226,739
Electrical	203,991	224,679	262,238	295,089	337,174	395,661	449,530	499,312
Mechanical	141,035	142,326	148,763	178,308	206,321	226,762	274,643	301,649
Other, n.e.c.	387,052	408,743	431,696	446,495	523,346	613,362	715,212	778,274
All sciences, total	5,861,473	6,272,846	6,740,514	7,375,151	8,249,732	9,267,446	10,195,106	11,338,392
Physical sciences	765,165	822,966	899,366	995,019	1,144,120	1,281,061	1,381,748	1,531,560
Astronomy	67,259	73,125	73,442	78,396	93,856	99,417	108,226	118,814
Chemistry	284,774	308,049	334,977	371,585	421,506	468,778	509,512	565,637
Physics	356,880	366,445	416,713	470,977	548,715	628,295	661,571	725,667
Other, n.e.c.	56,252	75,347	74,234	74,061	80,043	84,571	102,439	121,442
Environmental sciences	549,948	558,084	616,636	644,932	702,086	773,468	828,341	890,914
Atmospheric	87,581	86,668	98,637	106,112	111,025	122,811	129,677	140,766
Earth sciences	190,338	195,345	216,256	226,590	253,242	275,248	286,111	297,129
Oceanography	192,274	198,202	223,931	233,694	254,084	276,498	297,979	328,146
Other, n.e.c.	79,755	77,869	77,812	78,536	83,735	98,911	114,574	124,873
Mathematical sciences	86,942	96,382	106,295	123,082	127,757	151,712	178,073	198,730
Computer sciences	131,869	148,504	174,964	223,815	280,782	320,916	372,317	409,680
Life sciences	3,689,461	4,008,426	4,299,137	4,705,996	5,272,209	5,885,387	6,476,025	7,236,111
Agricultural sciences	788,214	864,496	921,274	953,864	999,280	1,089,323	1,119,484	1,199,322
Biological sciences	1,187,953	1,286,066	1,418,826	1,571,549	1,779,445	1,946,440	2,132,583	2,352,253
Medical sciences	1,601,091	1,734,525	1,827,771	2,030,382	2,313,373	2,610,585	2,964,417	3,374,908
Other, n.e.c.	112,203	123,339	131,266	150,201	180,111	239,039	259,541	309,628
Psychology	127,267	130,525	135,616	145,551	158,345	170,482	188,374	214,065
Social sciences	366,247	352,170	343,797	358,032	379,580	458,578	499,480	549,695
Economics	97,843	94,359	97,409	108,258	116,580	134,220	148,827	161,329
Political science	55,114	60,057	54,451	56,132	58,647	68,088	80,222	87,292
Sociology	93,563	78,449	76,821	70,206	73,824	94,849	94,820	109,899
Other, n.e.c.	119,727	119,305	115,116	123,436	130,529	161,421	175,611	191,175
Other sciences, n.e.c.	144,574	155,789	164,703	178,724	184,853	225,842	270,748	307,637

Source: National Science Foundation, SRS

Table B-34.-- Federally financed R&D expenditures at universities and colleges by character of work and science/engineering field: fiscal years 1981-88

(dollars in thousands)

Character and field	1981	1982	1983	1984	1985	1986	1987	1988
Total	4,560,568	4,758,632	4,979,611	5,416,677	6,055,820	6,701,503	7,328,388	8,164,801
Character of work:								
Basic research	3,248,606	3,391,823	3,537,850	3,816,364	4,341,371	4,865,782	5,372,428	5,661,442
Applied research and development	1,311,962	1,366,809	1,441,761	1,600,313	1,714,449	1,835,721	1,955,960	2,503,359
Field:								
Engineering, total	662,334	697,476	739,475	779,937	865,577	975,413	1,108,069	1,224,617
Aeronautical and astronautical	41,649	47,687	52,255	52,459	68,031	79,302	88,171	96,318
Chemical	47,934	49,657	52,255	54,055	57,793	66,328	69,322	79,153
Civil	61,182	59,247	63,246	71,842	78,074	87,500	88,532	102,994
Electrical	156,062	173,903	193,618	209,673	228,415	260,807	291,485	327,456
Mechanical	95,224	97,427	100,117	118,672	133,184	146,931	177,646	190,881
Other, n.e.c.	260,283	269,555	277,984	273,236	300,080	334,545	392,913	427,815
All sciences, total	3,898,234	4,061,156	4,240,136	4,636,740	5,190,243	5,726,090	6,220,319	6,940,184
Physical sciences	618,886	649,604	699,645	779,454	887,741	979,025	1,041,619	1,144,661
Astronomy	47,778	51,610	49,916	52,111	63,195	68,358	71,400	77,296
Chemistry	216,681	230,441	247,567	279,274	312,831	337,735	365,244	403,018
Physics	308,834	306,389	342,451	388,825	451,955	508,893	527,972	573,348
Other, n.e.c.	45,593	61,164	59,711	59,244	59,760	64,039	77,003	90,999
Environmental sciences	391,415	391,334	426,200	446,130	473,245	516,539	541,869	584,068
Atmospheric	67,512	69,313	77,396	84,727	88,246	99,694	107,189	113,877
Earth sciences	127,985	126,956	135,079	139,473	153,817	159,979	161,349	172,841
Oceanography	149,851	153,443	171,542	179,377	186,331	207,192	218,192	236,807
Other, n.e.c.	46,067	41,622	42,183	42,553	44,851	49,674	55,139	60,543
Mathematical sciences	67,651	71,800	76,454	92,278	96,986	114,305	132,224	148,869
Computer sciences	93,330	106,913	127,661	162,670	195,459	232,227	256,979	289,135
Life sciences	2,365,421	2,503,296	2,586,953	2,828,355	3,185,735	3,490,657	3,827,076	4,311,143
Agricultural sciences	234,596	255,524	261,607	269,112	294,488	292,262	293,749	320,205
Biological sciences	867,535	919,207	986,826	1,093,373	1,208,084	1,311,876	1,413,877	1,570,673
Medical sciences	1,186,998	1,249,866	1,258,765	1,371,775	1,575,252	1,740,205	1,964,111	2,234,224
Other, n.e.c.	76,292	78,699	79,755	94,095	107,911	146,314	155,339	186,041
Psychology	92,618	88,981	89,639	98,174	106,180	114,050	124,413	140,307
Social sciences	187,088	161,160	146,794	142,686	152,927	172,036	170,207	188,001
Economics	44,457	41,422	38,710	42,424	43,709	45,402	45,942	49,173
Political science	23,294	22,553	20,119	18,929	19,612	20,047	23,957	25,426
Sociology	56,724	45,863	42,564	37,911	39,489	48,819	44,263	48,842
Other, n.e.c.	62,613	51,322	45,401	43,422	50,117	57,768	56,045	64,560
Other sciences, n.e.c.	81,825	88,068	86,790	86,993	91,970	107,251	125,932	134,000

Source: National Science Foundation, SRS

Table B-35. -- Capital expenditures at universities and colleges by science/engineering field and source of funds: fiscal years 1981-88 1/

(dollars in thousands)

Field and source	1981	1982	1983	1984	1985	1986	1987	1988
Total	954,795	965,488	1,093,618	1,175,904	1,229,779	1,499,116	1,747,851	1,966,902
Engineering	105,768	147,285	137,188	147,055	184,025	314,796	380,302	366,529
All sciences, total	849,027	818,203	956,430	1,028,849	1,045,754	1,184,320	1,367,549	1,600,373
Physical sciences	89,106	83,536	98,131	110,673	115,683	144,023	159,702	209,192
Environmental sciences	36,834	44,052	42,224	36,358	54,634	49,006	54,158	58,605
Mathematical/computer sciences	31,913	35,661	54,216	48,921	77,226	90,603	83,424	96,280
Life sciences	592,020	578,618	668,453	716,962	697,668	772,029	915,089	1,056,418
Psychology	11,183	13,003	16,757	31,319	12,807	17,816	9,775	11,156
Social sciences	45,742	31,382	40,942	46,964	60,748	49,919	55,231	80,787
Other sciences, n.e.c.	42,229	31,951	35,707	37,652	26,988	60,924	90,170	87,935
Federal sources, total	161,043	126,679	135,359	142,473	110,959	170,572	196,429	208,566
Engineering	19,150	20,962	18,425	30,641	16,793	37,536	49,445	46,738
All sciences, total	141,893	105,717	116,934	111,832	94,166	133,036	146,984	161,828
Physical sciences	26,693	22,076	19,605	20,713	31,497	38,108	41,090	37,344
Environmental sciences	8,352	6,029	4,664	4,828	4,153	8,214	15,257	13,197
Mathematical/computer sciences	5,649	5,049	5,516	8,697	8,918	17,516	12,936	19,764
Life sciences	90,767	67,368	79,412	72,717	44,448	57,840	59,053	73,636
Psychology	1,784	1,222	1,101	1,035	871	1,739	1,081	2,335
Social sciences	7,150	2,214	5,278	3,209	2,493	3,618	4,852	7,992
Other sciences, n.e.c.	1,498	1,759	1,358	633	1,786	6,001	12,715	7,560
Other sources, total	793,752	838,809	958,259	1,033,431	1,118,820	1,328,544	1,551,422	1,758,336
Engineering	86,618	126,323	118,763	116,414	167,232	277,260	330,857	319,791
All sciences, total	707,134	712,486	839,496	917,017	951,588	1,051,284	1,220,565	1,438,545
Physical sciences	62,413	61,460	78,526	89,960	84,186	105,915	118,612	171,848
Environmental sciences	28,482	38,023	37,560	31,530	50,481	40,792	38,901	45,408
Mathematical/computer sciences	26,264	30,612	48,700	40,224	68,308	73,087	70,488	76,516
Life sciences	501,253	511,250	589,041	644,245	653,220	714,189	856,036	982,782
Psychology	9,399	11,781	15,656	30,284	11,936	16,077	8,694	8,821
Social sciences	38,592	29,168	35,664	43,755	58,255	46,301	50,379	72,795
Other sciences, n.e.c.	40,731	30,192	34,349	37,019	25,202	54,923	77,455	80,375

1/ Includes expenditures for facilities and equipment for research, development, and instruction.

Source: National Science Foundation, SRS

Table B-36. -- R&D expenditures at university-administered federally funded research and development centers by character of work and science/engineering field: fiscal years 1981-88

(dollars in thousands)

Character and field	1981	1982	1983	1984	1985	1986	1987	1988
Total	2,485,853	2,478,721	2,736,652	3,150,380	3,523,092	3,894,806	4,206,084	4,530,562
Character of work:								
Basic research	1,261,075	1,317,312	1,472,199	1,675,204	1,749,450	1,858,692	2,011,932	2,222,097
Applied research and development	1,224,778	1,161,409	1,264,453	1,475,176	1,773,642	2,036,114	2,194,152	2,308,465
Field:								
Engineering, total	656,426	636,158	944,952	1,097,444	1,296,043	1,445,252	1,547,061	1,647,378
Aeronautical and astronautical	60,339	59,409	69,057	86,022	107,065	126,566	132,238	146,894
Chemical	47,454	44,988	45,832	39,230	40,082	40,048	41,884	43,964
Civil	16,052	17,952	13,378	13,596	15,597	16,014	17,568	17,500
Electrical	169,059	171,470	316,652	390,967	454,233	514,263	550,430	572,181
Mechanical	185,448	181,017	339,573	396,962	489,469	540,103	570,698	602,857
Other, n.e.c.	178,074	161,322	160,460	170,667	189,597	208,258	234,243	263,982
All sciences, total	1,829,427	1,842,563	1,791,700	2,052,936	2,227,049	2,449,554	2,659,023	2,883,184
Physical sciences	1,263,967	1,311,721	1,192,067	1,369,108	1,448,808	1,540,627	1,660,404	1,756,353
Astronomy	61,006	61,980	69,108	77,683	73,330	79,047	82,360	85,609
Chemistry	167,148	161,548	200,505	221,002	226,440	246,911	261,267	274,647
Physics	950,865	982,245	885,500	1,023,210	1,097,949	1,159,738	1,257,808	1,334,837
Other, n.e.c.	84,948	105,948	36,954	47,213	51,089	54,931	58,969	61,260
Environmental sciences	193,098	161,867	159,032	175,152	200,074	232,606	257,800	289,352
Atmospheric	55,005	59,230	61,139	66,604	83,498	99,017	103,504	115,564
Earth sciences	42,715	37,334	37,795	42,913	46,552	50,361	55,947	57,169
Oceanography	14,276	12,201	13,068	15,196	16,056	19,489	22,361	24,785
Other, n.e.c.	81,102	53,102	47,030	50,439	53,968	63,739	75,988	91,834
Mathematical sciences	38,561	42,091	65,340	81,376	92,858	109,102	121,793	126,084
Computer sciences	188,066	177,106	224,274	266,268	338,116	427,297	472,766	549,444
Life sciences	85,164	84,269	104,484	106,313	110,905	107,506	115,416	123,508
Agricultural sciences	570	2,528	1,008	639	633	663	684	1,397
Biological sciences	66,406	62,180	76,437	80,730	82,057	85,195	87,202	91,712
Medical sciences	8,453	8,575	9,555	11,093	10,729	8,572	10,570	12,996
Other, n.e.c.	9,735	10,986	17,484	13,851	17,486	13,076	16,960	17,403
Psychology	147	155	194	240	264	294	899	973
Social sciences	20,984	21,412	21,067	18,056	17,591	19,343	21,421	27,868
Economics	6,002	4,556	4,254	3,590	4,401	4,043	2,554	1,477
Political science	3,439	3,428	3,955	3,319	4,038	4,994	4,563	5,843
Sociology	2,259	2,487	0	0	0	0	0	0
Other, n.e.c.	9,284	10,941	12,858	11,147	9,152	10,306	14,304	20,548
Other sciences, n.e.c.	39,440	43,942	25,242	36,423	18,433	12,779	8,524	9,602

Source: National Science Foundation, SRS